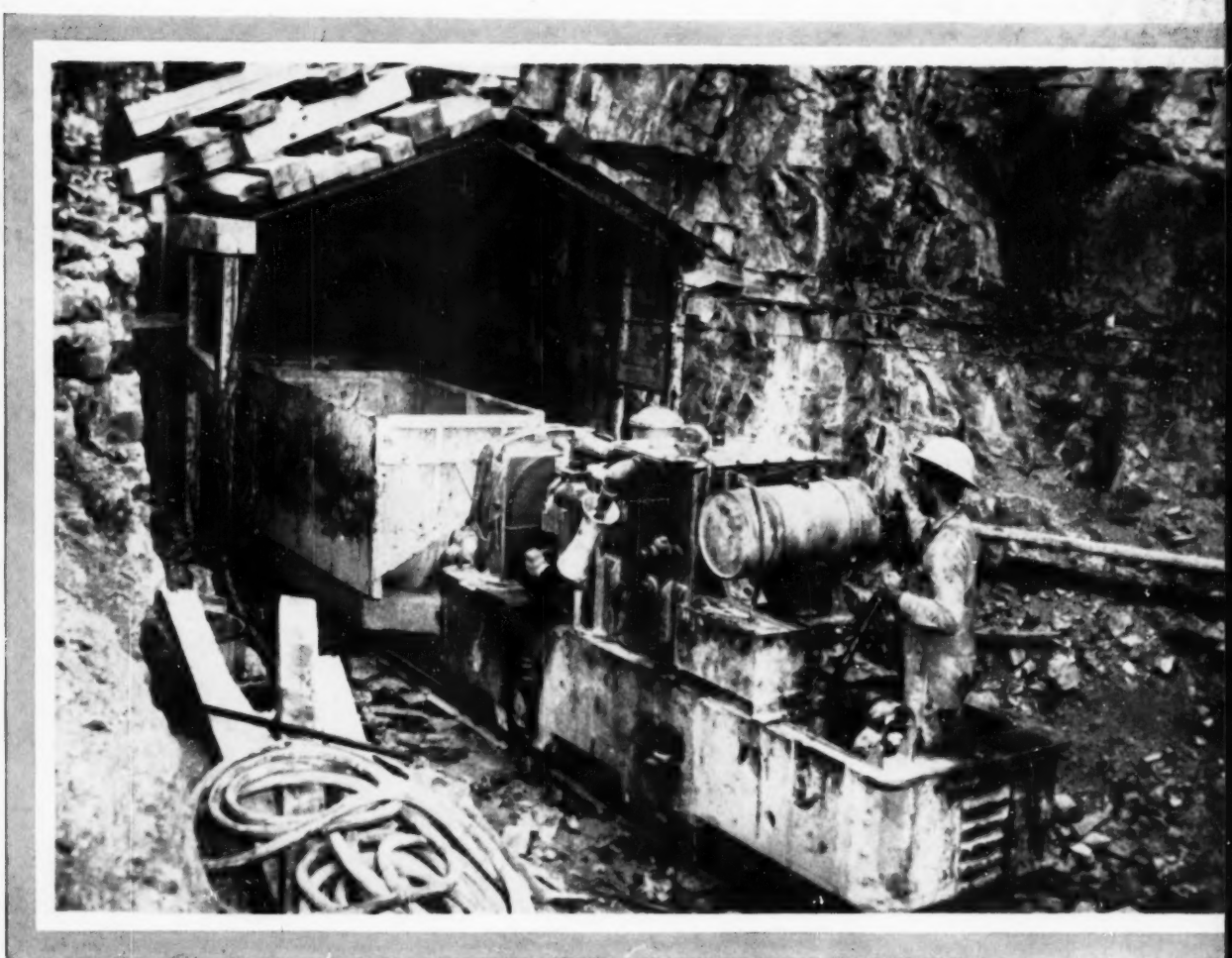
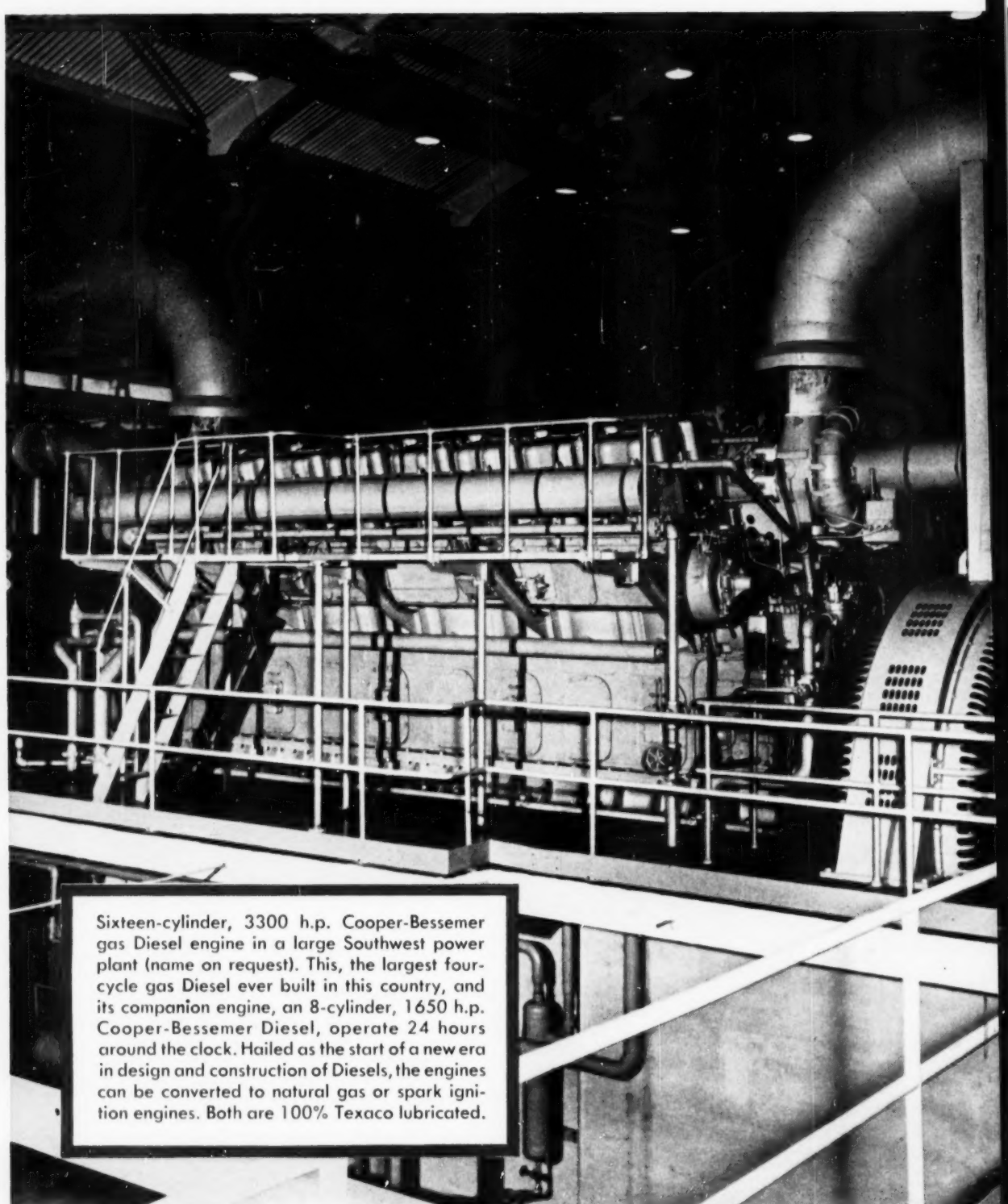
DIESEL POWER

AND DIESEL TRANSPORTATION

NOVEMBER, 1952



- ***Roosa Master Fuel Injection Pump***
- ***Dual-Fuel Economy for Sewage Disposal***
- ***A Look at Combustion in Gas Engines***


Sixteen-cylinder, 3300 h.p. Cooper-Bessemer gas Diesel engine in a large Southwest power plant (name on request). This, the largest four-cycle gas Diesel ever built in this country, and its companion engine, an 8-cylinder, 1650 h.p. Cooper-Bessemer Diesel, operate 24 hours around the clock. Hailed as the start of a new era in design and construction of Diesels, the engines can be converted to natural gas or spark ignition engines. Both are 100% Texaco lubricated.

TUNE IN:
Tuesday nights
on television —
the TEXACO STAR THEATER
starring MILTON BERLE.

See newspaper for
time and station.

TEXACO

REG. T.M.

TEXACO

DIESEL POWER and DIESEL TRANSPORTATION for Nov., 1952, Vol. XXX, No. 11. It is published monthly by Diesel Publications, Inc., Orange, Conn. Executive and Editorial offices at 192 Lexington Ave., New York 16, N. Y. Subscription rate: United States, $3.00 per year, single copies 35¢; Canada $4.00. Foreign $5.00 per year. Entered as second class matter April 29, 1949 at the Post Office, Orange, Connecticut under Act of March 3, 1879.

MORE POWER ...LESS FUEL

...when you use TEXACO URSA OIL

DIESEL, gas or dual-fuel, you can assure cleaner engines — more power with less fuel — by lubricating with *Texaco Ursa Oil*. This means you'll also spend less for maintenance.

Texaco Ursa Oil has extra-strong resistance to oxidation . . . keeps out the formations of carbon, gum and sludge that loot your power . . . assures the free rings, clear ports and snappy valves that mean proper compression and combustion. *Texaco Ursa Oil* stands up in the toughest service . . . gives the protection against wear that means longer life for bearings, pistons and liners.

There is a complete line of *Texaco Ursa Oils* approved by leading engine builders. You can get one exactly right to bring out the best performance in your engines. And when you use *Texaco Ursa Oil* you'll be in good company because —

For over 15 years, more stationary Diesel h.p. in the U.S. has been lubricated with Texaco than with any other brand.

A Texaco Lubrication Engineer will gladly help you get the most in efficiency at the least possible cost from your engines. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

URSA OILS FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

Faithfully yours 50 *for Fifty Years*

OGDEN SAVES $10,000 A YEAR ON FUEL ALONE!

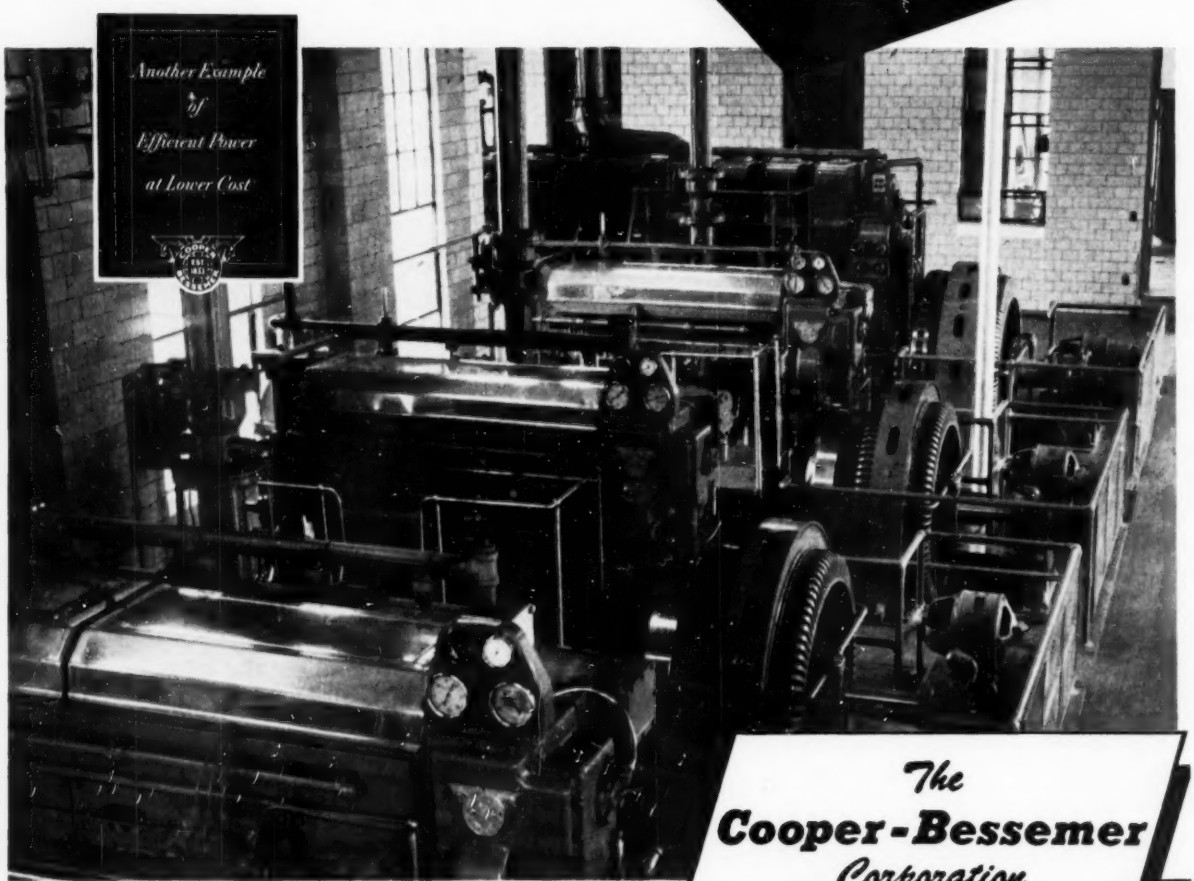
THE engines shown below are cost-cutting Cooper-Bessemer Gas-Diesels in the extremely modern, highly efficient Municipal Electric Plant at Ogden, Iowa.

Ogden's plant was completed in 1936. It was Cooper-Bessemer-powered from the start with three of these same engines, originally oil fueled. Following Cooper-Bessemer's development of the Gas-Diesel, the engines were converted and a new JS-8 Gas-Diesel added . . . in 1951.

Today, thanks to full Gas-Diesel operation and the high efficiency of these Cooper-Bessemer engines, fuel costs are actually running over $10,000 less than they would with full oil operation.

Why not check with us on the advantages you stand to gain with Cooper-Bessemer Gas-Diesels or other new-type Cooper-Bessemers on the job?

. . . with these Cooper-Bessemer Gas-Diesels

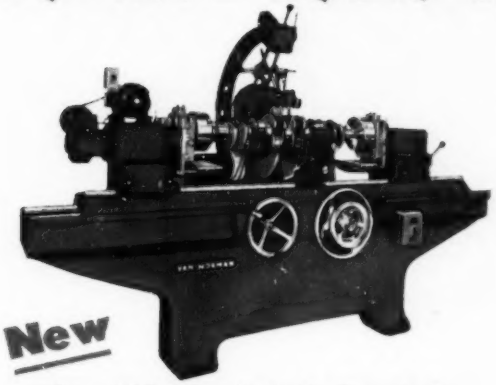


The Cooper-Bessemer Corporation

MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York Washington, D. C. Bradford, Pa. San Francisco Houston, Dallas, Greggton, Pampa and Odessa, Texas Seattle Tulsa Shreveport St. Louis Los Angeles Chicago Caracas, Venezuela Cooper-Bessemer of Canada, Ltd., Halifax, Nova Scotia Gloucester, Mass. New Orleans, La.

4 Answers to: What's New at Van Norman...



New

No. 460 Crankshaft Regrinder

Equipped with new Rap-O-Matic wheel head control. Capacity 60" x 18". Stroke capacity up to 7". Van-O-Lite Polisher available.

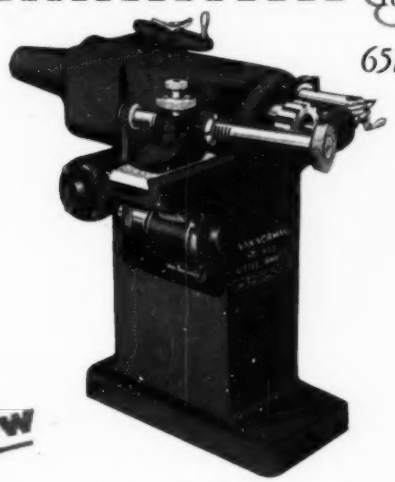
New

No. 562 Head Grinder

Brand new rugged, high speed cylinder head and block grinder. *Wet Type* for accuracy finish and no dust. Capacity 46" long x 14" wide. Automatic feed. A real profit builder.

1888 1953

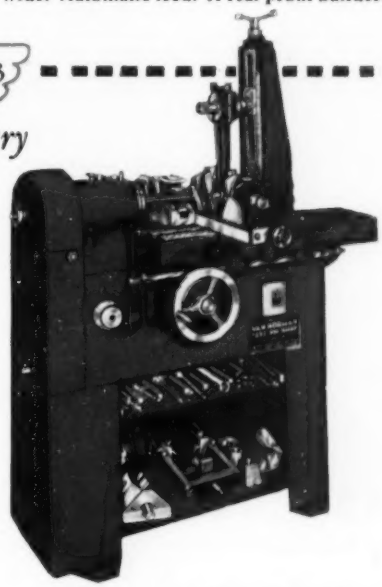
65th Anniversary



New

"Little Brute" No. 302 Brake Drum Lathe

A new low cost heavy-duty compact brake drum lathe. Handles drums up to 24" diameter, 10" wide. Turns and grinds simultaneously. Takes all passenger car and 2½ ton drums with wheels and tires mounted. Handles extra heavy truck drums.



No. 232 "Pin Shop"

Not brand new in the field — *but still big news as a profit-builder.* Reconditions rods, fits pins to rods, then fits pins to pistons . . . *faster and more accurately* than any other method.

There are Van Norman Machines to do the best work on brake drums, cylinders, cylinder heads, block tops, valves, crankshafts, piston pins, con-rods, clutch plates and clutch sides of flywheels. ALWAYS LOOK TO VAN NORMAN FOR THE *BIG NEWS* IN AUTOMOTIVE SERVICE EQUIPMENT and see why "It's Wise to Van Normanize." Van Norman Co., Springfield 7, Mass.

The Best-Equipped Shop Gets the Business! — that's why **"It Pays to Van Normanize"**

NEW!

EXIDE DIESEL STARTING BATTERY

EXTRA LONG LIFE! This new line of Exide heavy-duty batteries assures you:

QUICK BREAKAWAY
and fast acceleration of engine to firing speed.

LOW DEPRECIATION due to their extra long life.

RUGGED CONSTRUCTION
for rough usage in hard service.

LOW COSTS of operation and maintenance.

OUTSTANDING FEATURES

NEW GRID ALLOY • NEW ACTIVE MATERIAL—G.O.X.
LOWER OPERATING GRAVITIES • NEW DUAL INSULATION

This combination results in longer battery life, lower internal resistance, reduction of standing losses, and sustained battery capacity.

The new Exide also has an improved container and cover, new vibration-proof, heat-resistant sealing compound and new vent plugs.

THE ELECTRIC STORAGE BATTERY CO., Philadelphia 2
Exide Batteries of Canada, Limited, Toronto

"EXIDE" *Reg. T. M. U. S. Pat. Off.*

Now, more than ever before

EXIDE IS YOUR BEST BATTERY BUY... AT ANY PRICE

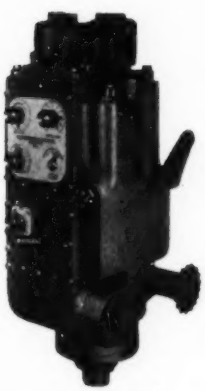
1888... DEPENDABLE BATTERIES FOR 64 YEARS... 1952

PICKERING GOVERNORS

PRECISION-BUILT BY BUEHLER

FOR • STEAM • DIESEL AND GAS • ENGINES
NOW • AVAILABLE • IN • ALL • TYPES • AND • SIZES

2200 Class
Mechanical Governor



3700 Class
Hydraulic Governor

2600 Class
Mechanical Governor

3200 Class
Hydraulic Governor

THE PICKERING GOVERNOR CO.
ESTABLISHED 1864
affiliated with BUEHLER INC.
ROUTE 17 — SOUTH OF ROUTE 4
PARAMUS—NEW JERSEY
Phone HUbbard 7-1600

HAMILTON DIESELS are Worth Looking Into!

1 combustion chamber
Large chamber with semi-hemispherical contours eliminates fuel oil impingement and ensures high-velocity mixing of fuel and air. Combustion is unusually efficient even with low-grade fuels.

2 cast iron piston
. . . is cooled by high-velocity oil circulation. Properly-proportioned cooling areas insure efficient cooling of rings and an even temperatue throughout head.

3 camshaft
Large diameter gear-driven camshaft eliminates vibration and maintains positively-timed sequences for all cylinders. Overhead location permits easy access to crankcase and upper level of engine . . . cuts length of high-pressure fuel injection lines.

4 rotary exhaust valve
Exclusive Hamilton design entraps 40% more air in cylinder to give the best *proven* performance characteristics of any comparable engine.

5 porting
Inlet and exhaust porting functions as a complement to rotary valve and entire scavenging system. Streamlined port contour permits free flow of air well above maximum rated speed. Piston rings and liners last longer because ports are located on the low-pressure thrust side of cylinder.

6 water jackets
. . . are designed to insure an even thermogradient throughout the engine. Water makes two passes around block and is then directed under high-velocity across the port area and around the combustion space.

7 air manifold
. . . is streamlined for optimum flow characteristics. Full air flow is immediately available during scavenging period.

8 crankcase access
Overhead location of camshaft allows extremely large access doors on camshaft side. Both sides of crankcase, bedplate and upper base can be easily reached for maintenance and inspection.

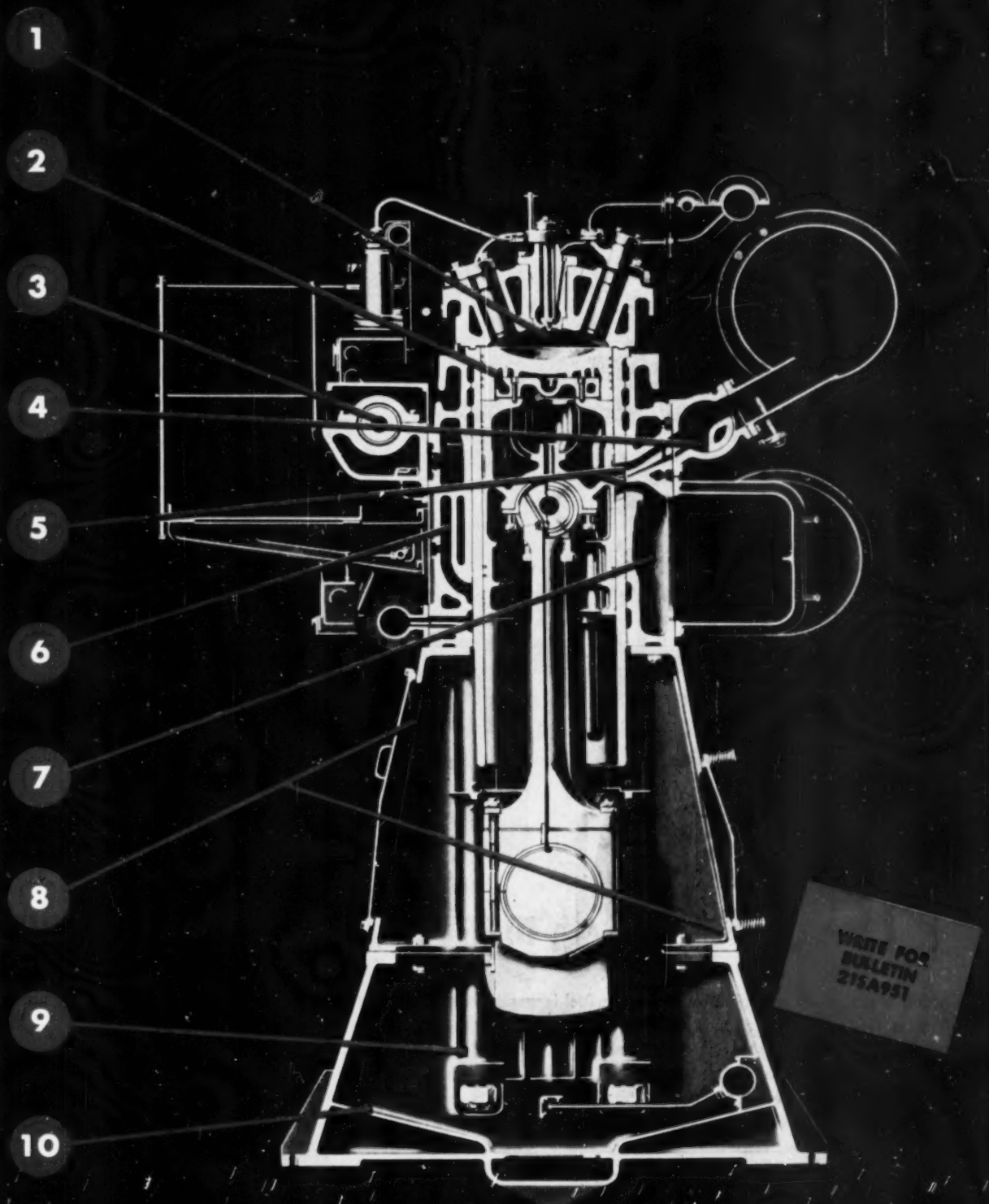
9 tie rods
Pre-stressed rods tie bedplate, upper base and cylinder blocks firmly together . . . relieve structure of combustion load and hold it in compression even under extreme load.

10 welded construction
. . . of upper base provides unusual rigidity. Bedplate is either high-tensile cast iron or welded steel.

BALDWIN BLH LIMA-HAMILTON

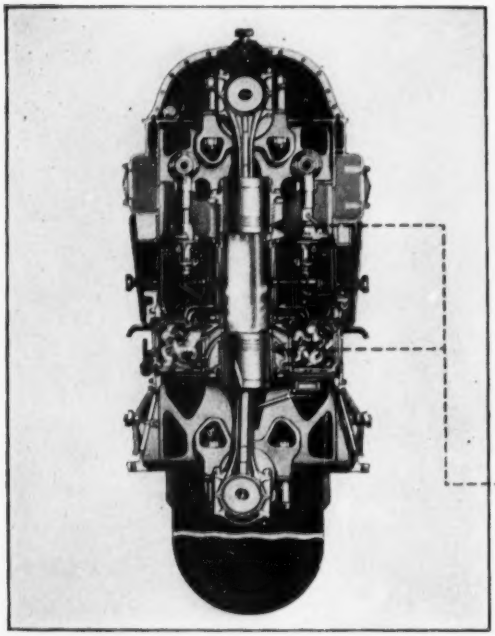
Lima-Hamilton Division

BALDWIN

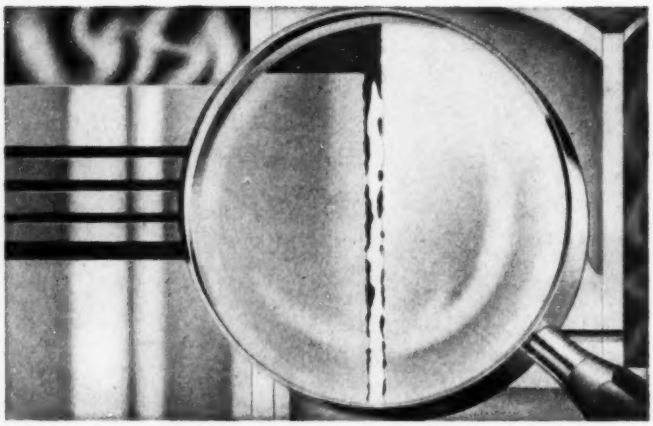


BALDWIN-LIMA-HAMILTON CORPORATION Hamilton, Ohio

-LIMA-HAMILTON

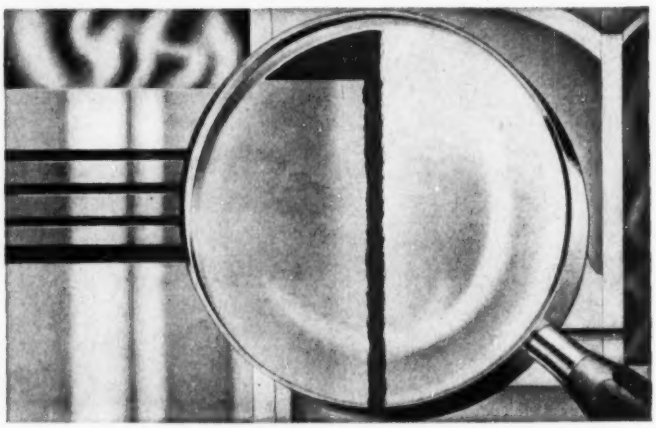


←That demon friction... not only at the points indicated here, but with all moving parts throughout any engine . . . can steal up to 50% of the power produced by your fuel.



↑ *Drawing above* illustrates how inferior diesel oils . . . oils with weak film strength and less free-flowing qualities . . . provide insufficient lubrication and set up friction points.

↓ *Shown below* is the complete coverage Cities Service D-C Oils provide. They provide a strong, adequate oil film, a positive seal between piston rings and cylinder walls.



POWER LOSS DUE TO FRICTION must be held to a minimum

Much of the power generated by any motor fuel is wasted in overcoming friction. But this loss must, and can be held to a minimum with the proper lubricants . . . Cities Service Diesel Lubricants.

With exceptionally high film-strength and free-flowing qualities, Cities Service Diesel Oils provide a perfect oil film between all moving parts and thorough lubrication of the most intricate diesel mechanisms under severest operating conditions. They reduce power-stealing friction to the barest minimum.

Be sure you're getting all the power your diesels were designed to give. Use the complete line of Cities Service D-C Oils. Ask your Cities Service Representative, or call the office nearest you.

CITIES SERVICE DIESEL OILS ALSO:

- **Minimize wear under all conditions.**
- **Provide a positive seal between piston rings and cylinder walls.**
- **Serve as a coolant to fight heat.**
- **Clean as they lubricate.**

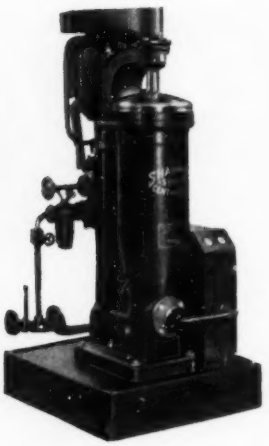
CITIES SERVICE

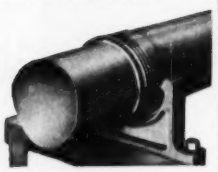
EMERGENCY POWER....
PROTECTS this BOAT!
The INSTANT the ship's power fails—SYNCHRO-START Controls AUTOMATICALLY start the stand-by engine generator set, and if desired, will provide necessary emergency illumination from the engine's battery until the voltage is up to normal.
SYNCHRO-START Automatic Controls are constantly protecting lives and property all over the world—on the seas, in the air, on land or in the mines.
The vital function of any engine, to supply a continuous flow of power, depends upon a reliable Automatic Control.
If you are not acquainted with the SAFETY and the ECONOMY provided by SYNCHRO-START Controls, ask your engine manufacturer—engine dealer—engineering firm—architect or write for our catalog.
SYNCHRO-START PRODUCTS, INC.
Automatic Engine Control Equipment
8151 N. RIDGEWAY AVE., SKOKIE, ILLINOIS

SHARPLES CENTRIFUGAL PURIFIERS

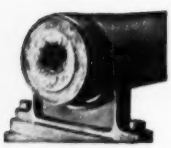
are *Quick* and *Easy to Clean*

10 MINUTES . . . back in service





1. Slip a loosely rolled paper liner into the bowl and push in the three-wing assembly.



2. After solids have accumulated, remove bowl bottom.

3. Screw extension sleeve on bowl shell and jar bowl loose by letting it drop by its own weight as illustrated.

4. Remove bowl extension sleeve and pull out entire bowl contents—which are neatly wrapped in the paper liner.

—SHARPLES PURIFIERS FOR

DIESEL LUBE OIL
DIESEL FUEL OIL
TURBINE LUBE OIL
BUNKER C FOR USE AS DIESEL FUEL

SHARPLES

THE SHARPLES CORPORATION • 2300 WESTMORELAND STREET, PHILADELPHIA 40, PENNA.

NEW YORK • PITTSBURGH • CLEVELAND • DETROIT • CHICAGO • NEW ORLEANS • SEATTLE • LOS ANGELES • SAN FRANCISCO • HOUSTON

FAIRBANKS-MORSE DIESELS CAN ELIMINATE YOUR

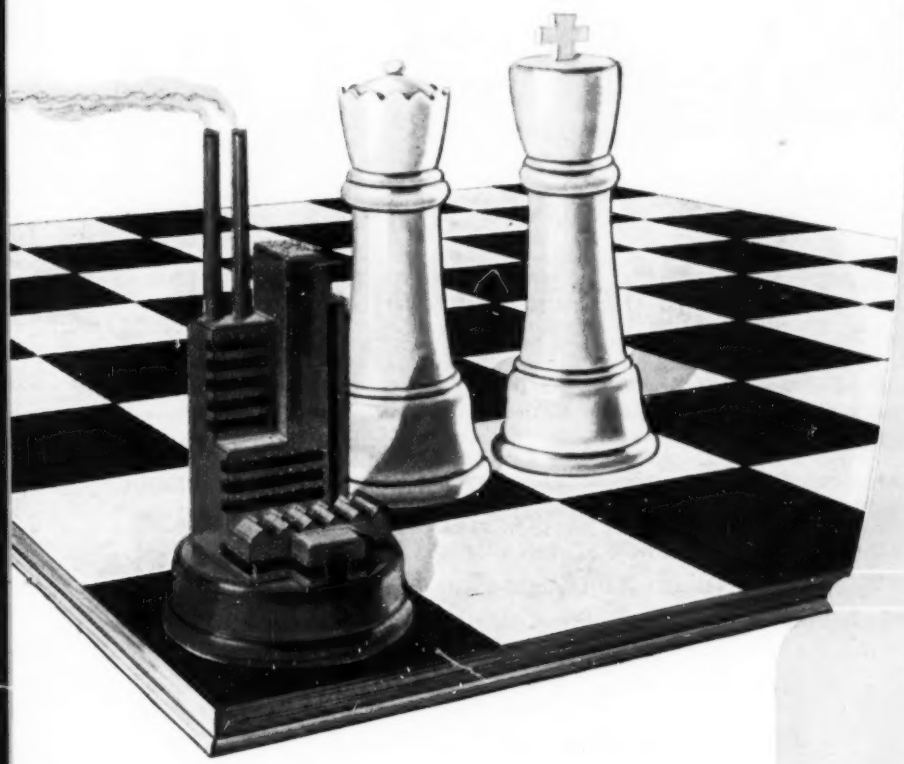
Power Checkmate

Poor power factor, adverse current characteristics, surge loads . . . any one of these conditions can put your plant in a power checkmate. You are then paying a penalty that can mean the difference between profit and loss.

What's the Next Move in *Your* Plant?

Look at your power problem. Then look at this representative list of advantages brought to you by Fairbanks-Morse Diesel power generation. These are *proved* answers to your problem . . . based on over 50 years' experience in industrial and municipal power generation.

If power has you in a checkmate, write us today, outlining your problem. Fairbanks-Morse Engineering can help decide your next move to put power costs and performance in order. Fairbanks, Morse & Co., Chicago 5, Ill.



Put Your Power Costs and Performance in Order

1 ***Handle Peak Demand***...reduce peak demand values for lower purchased power rates.

2 ***Power Factor*** . . . in-plant power generator can eliminate power factor penalties.

3 ***Emergency Power***... insurance against lost production and damage resulting from line failures.

4 ***Handle Surge Loads***... that may now be affecting current characteristics of entire plant.

5 ***Plant Expansion***...need not be restricted due to lack—or expense—of ample power.

6 ***Useful Heat*** . . . lube oil, water and exhaust heat can be turned from waste to profit.

7 ***Chemical Value*** . . . exhaust gases are high in free nitrogen—available for economical fixation of nitrates, ammonia, etc.

8 ***Insurance Advantage*** . . . of diesel over gasoline engine, for example, will soon pay for installation.

9 ***No Weather Worries***...ice, snow, sleet, wind storms can't stop plant operations.

10 ***Handle Increasing Load***... in-plant power economically adds to current capacity as loads increase.

11 ***Fuel Economy*** . . . use diesel oil, natural gas or sewage gas for added economy.

12 ***Remote Locations*** . . . distance from transmission lines needn't curtail plant expansion.

13 ***More Compact Power*** . . . Fairbanks-Morse engines give you more power per foot of floor space, more power on present foundation.

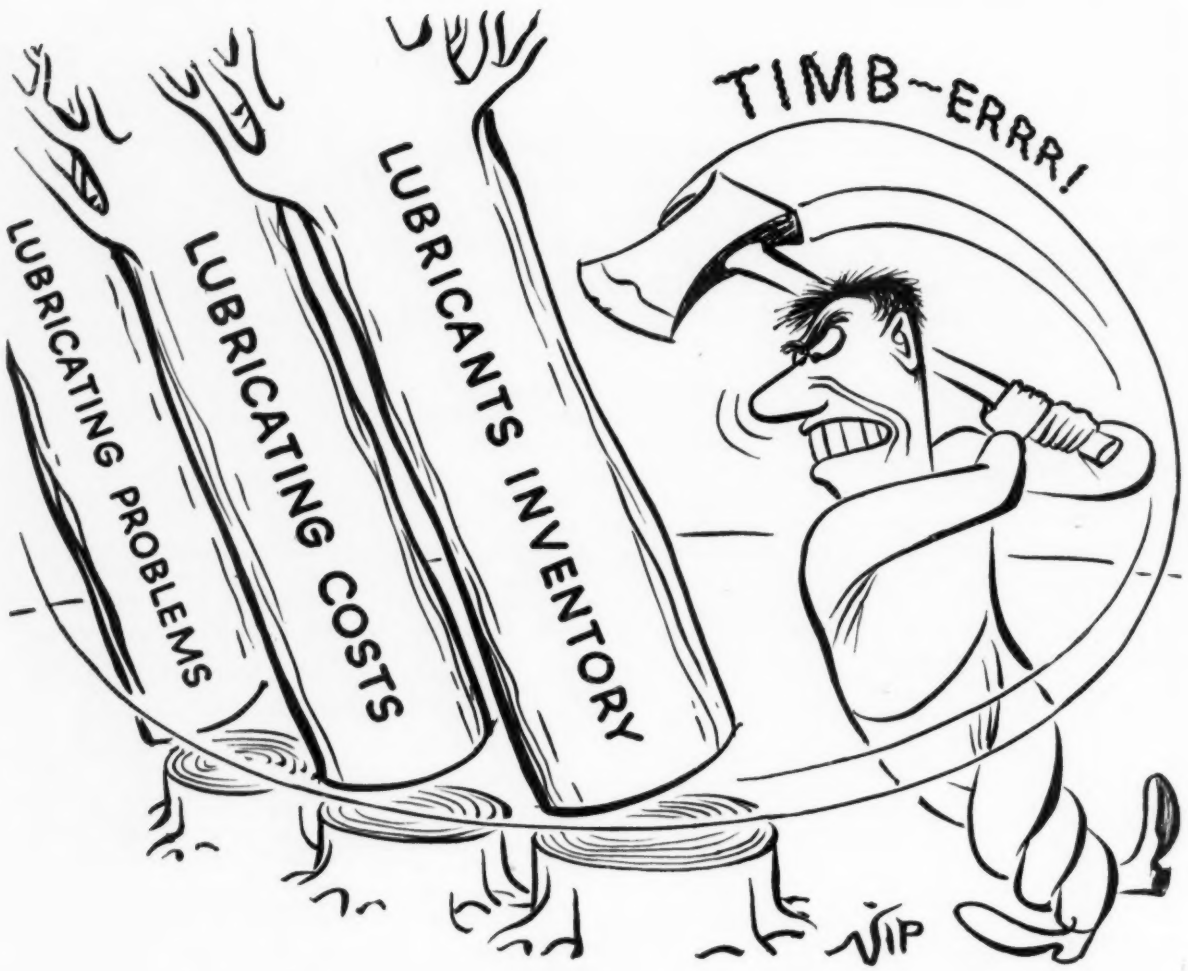
14 ***Minimum Attendance*** . . . Fairbanks-Morse in-plant generating sets require far less supervision or maintenance.

15 ***Save Cost*** . . . of running in new line where present transformers and power lines are already loaded.

FAIRBANKS-MORSE

a name worth remembering when you want the best

DIESEL AND DUAL FUEL ENGINES • DIESEL LOCOMOTIVES • ELECTRICAL MACHINERY • PUMPS • SCALES • RAIL CARS • MAGNETOS • FARM-MACHINERY



You can do it, too . . . with Pure Oil Industrial Lubricants

At one fell swoop, you can cut your inventory . . . cut your costs . . . cut your problems . . . with Pure Oil's complete line of industrial lubricants.

Many of these top-quality oils and greases, you see, are designed to do several *different* jobs instead of one specific job.

And to do each job *equally well.*

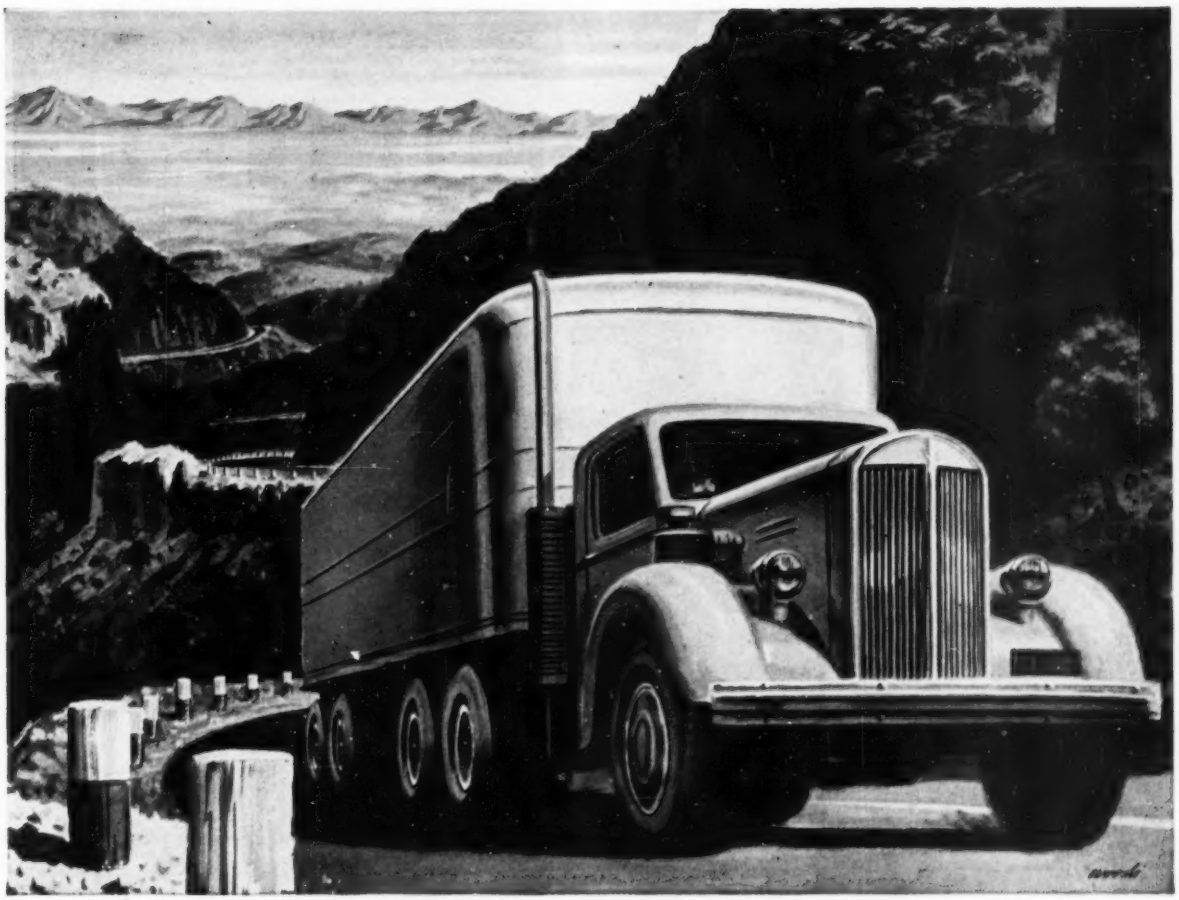
This enables you to do *all* your lubricating with *fewer* lubricants. In other words, you can

simplify and save . . . with Pure Oil Industrial Lubricants

If you would like to swing a sharp axe on *your* lubricating costs (and who wouldn't, things being what they are!) write: The Pure Oil Company, Industrial Sales, 35 E. Wacker Drive, Chicago 1, Illinois.

THE PURE OIL PURE COMPANY, U.S.A.

Be sure with Pure



tough jobs—EVERYWHERE demand AMERICAN BOSCH performance

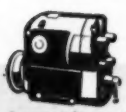
Hauling heavy loads through broiling desert heat and cold mountain passes is all in the day's work for many over-the-road truckers. Dependable, fast schedules are their stock in trade—and that's why you'll find American Bosch products on the job.

Many of the Diesel engines used to furnish the tremendous lugging power in these operations are equipped with American Bosch fuel injection systems—pumps, governors and nozzles that deliver the fuel . . . precisely timed and accurately metered to each engine cylinder, pressure atomized for maximum combustion efficiency.

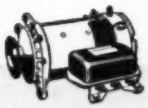
Other American Bosch products, too, contribute to performance and safety—heavy duty generators and voltage regulators that furnish the required current for batteries and the numerous electrical accessories—electric windshield wipers that provide constant clear vision for drivers regardless of engine speed or load.

Over 40 years of pioneering design, precision manufacture and thoroughgoing service have built the American Bosch reputation for dependability in the toughest going. Continuous research, development and field engineering assure that this reputation will grow even stronger through the years. American Bosch Corporation, Springfield 7, Mass.

AMERICAN BOSCH



Automotive and Aviation Magnetos

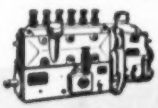


Generators and Regulators

Components for Aircraft Engines

All Electric Windshield Wipers

Ignition Coils



Diesel Fuel Injection Equipment

SERVING THE DIESELS THAT SERVE AMERICA...

DELCO-REMY

ELECTRICAL EQUIPMENT

Delco-Remy heavy-duty 12-volt cranking motor, with frame-mounted switch.

In almost every industry—in thousands of applications—Diesel engines have proved their economy and dependability as a source of power.

And Delco-Remy provides the electrical equipment for many of these powerful Diesels.

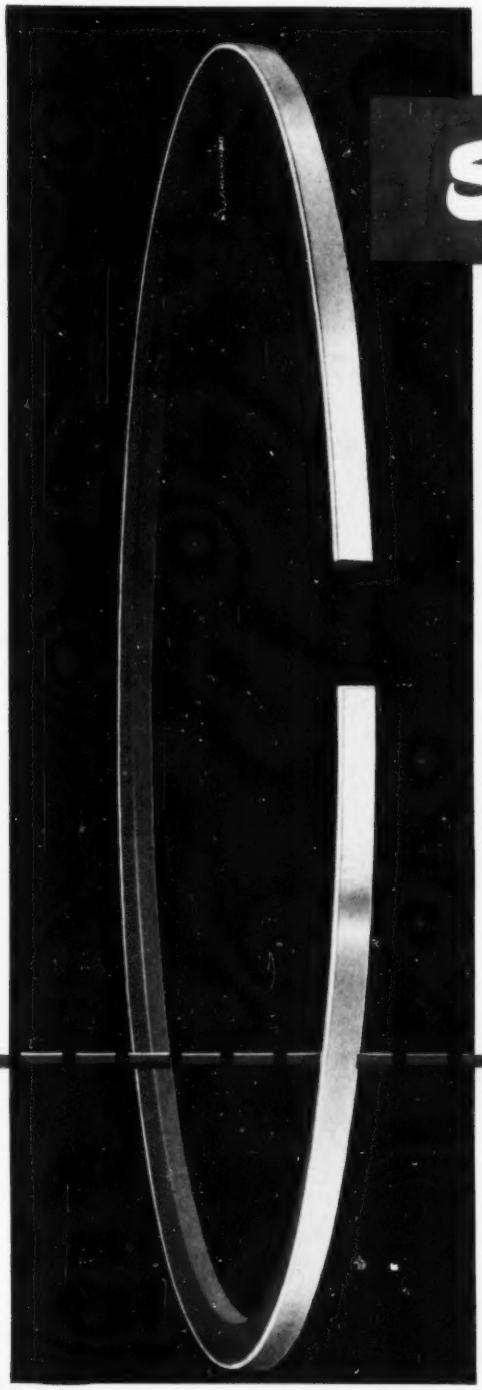
To user and manufacturer alike, the Delco-Remy name is a symbol of fine electrical equipment . . . equipment that helps keep their Diesels on the job.

UNITED SERVICE MOTORS

DELCO-REMY—
A UNITED MOTORS LINE
Service Parts and Delco Batteries
Available Everywhere Through
UNITED MOTORS DISTRIBUTORS

Delco-Remy
DIVISION, GENERAL MOTORS CORPORATION
ANDERSON, INDIANA

DELCO-REMY • WHEREVER WHEELS TURN OR PROPELLERS SPIN



Sealed Power

announces

Chrome-Faced

Cyclan

Top Groove Compression Ring

with chrome's unequalled resistance to

Heat, Friction, Corrosion, Abrasion

In addition to all the famous Cyclan advantages which include:

- High tensile strength alloy iron machined to Sealed Power's exacting specifications
- Extreme resistance to property changes under operating conditions
- High impact value for shock resistance
- High resistance to breakage plus ability to undergo considerable distortion prior to fracture without sacrificing resilience
- A structure that assures excellent wear qualities

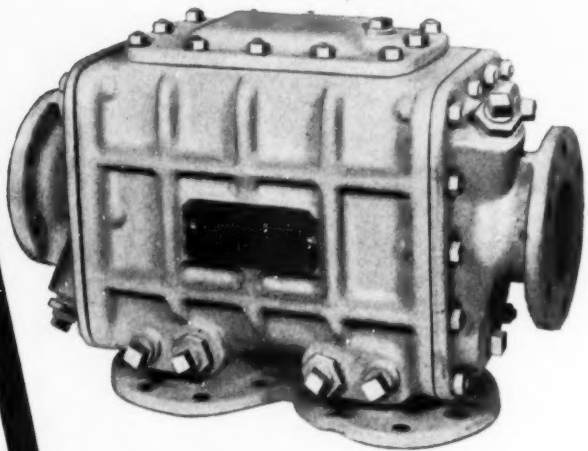
Write for complete information

SEALED POWER CORPORATION
MUSKEGON, MICHIGAN

Sealed Power

PISTON RINGS · PISTONS
CYLINDER SLEEVES

HARRISON



. . . dependable heat exchangers for every application

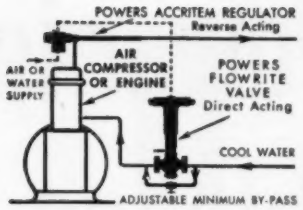
Harrison heat exchangers —oil coolers, water coolers —have earned the respect of Diesel manufacturers because they are efficient and dependable. These men know that Harrison heat exchangers combine high capacity with compactness and durability.

A Harrison heat exchanger with these recognized qualities is available to meet your requirements.

No matter what your heat transfer problem is, we welcome the opportunity to discuss it with you.

HARRISON

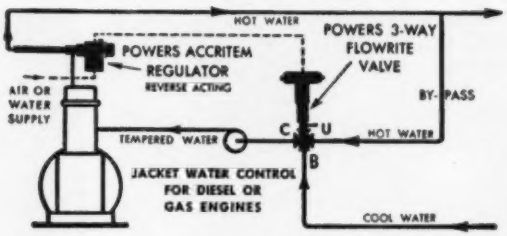
HARRISON RADIATOR DIVISION
GENERAL MOTORS CORPORATION
LOCKPORT, N. Y.



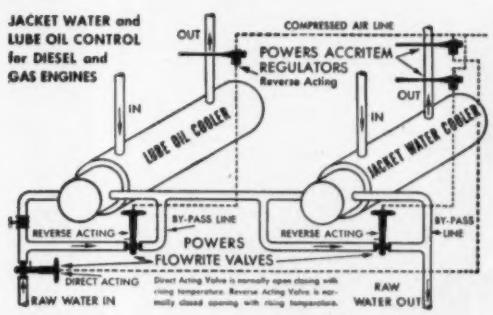
POWERS

ACCRITEM REGULATOR

Unsurpassed for reliability and power to operate large or small size 3-way or 2-way diaphragm valves for accurate control of jacket water and lube oil cooling temperatures.



Only a few of many applications are shown here.



Gives

Accurate, Low Cost Heat Control

Use Accritem Regulators to control diaphragm operated valves or dampers. They save labor, stop losses caused by over-heating and have the following —

IMPORTANT ADVANTAGES

- ***Adjustable Sensitivity*** and over-heat protection.
- ***Calibrated Dial*** temperature adjustment.
- ***Simple, Rugged Construction*** withstands vibration and insures many years of reliable service.
- ***Temperature Ranges*** 50 to 250° F. and 150 to 350° F.
- ***Easy to Install*** Requires 15 lb. supply of compressed air or water for its operation.
- ***Small Size*** — regulator head is only 2⅞" x 3⅝", sensitive bulb is 12" long with ½" I.P.S. connection.

Proper Cooling Temperatures assured by Powers Accritem Regulators

• Makes ignition easier • Prevents rapid breakdown of lube oil • Decreases cylinder and piston ring wear • Reduces danger of piston siezure • Lowers fuel and lube oil consumption

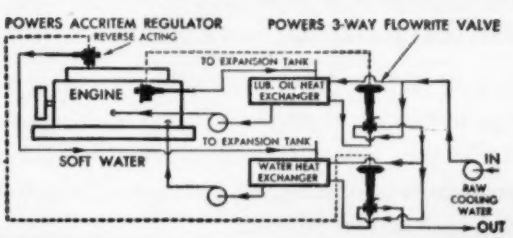
POWERS

FLOWRITE **and** METAFLOW

Diaphragm Valves controlled by a POWERS

ACCRITEM HEAT REGULATOR

provide an unbeatable combination for *better control and lower maintenance*



Write for Bulletin 316—or phone our nearest office for prices and further information about POWERS ACCRITEM regulators and diaphragm valves.

THE POWERS REGULATOR CO.

SKOKIE, ILL. • OFFICES IN OVER 50 CITIES • See Your Phone Book

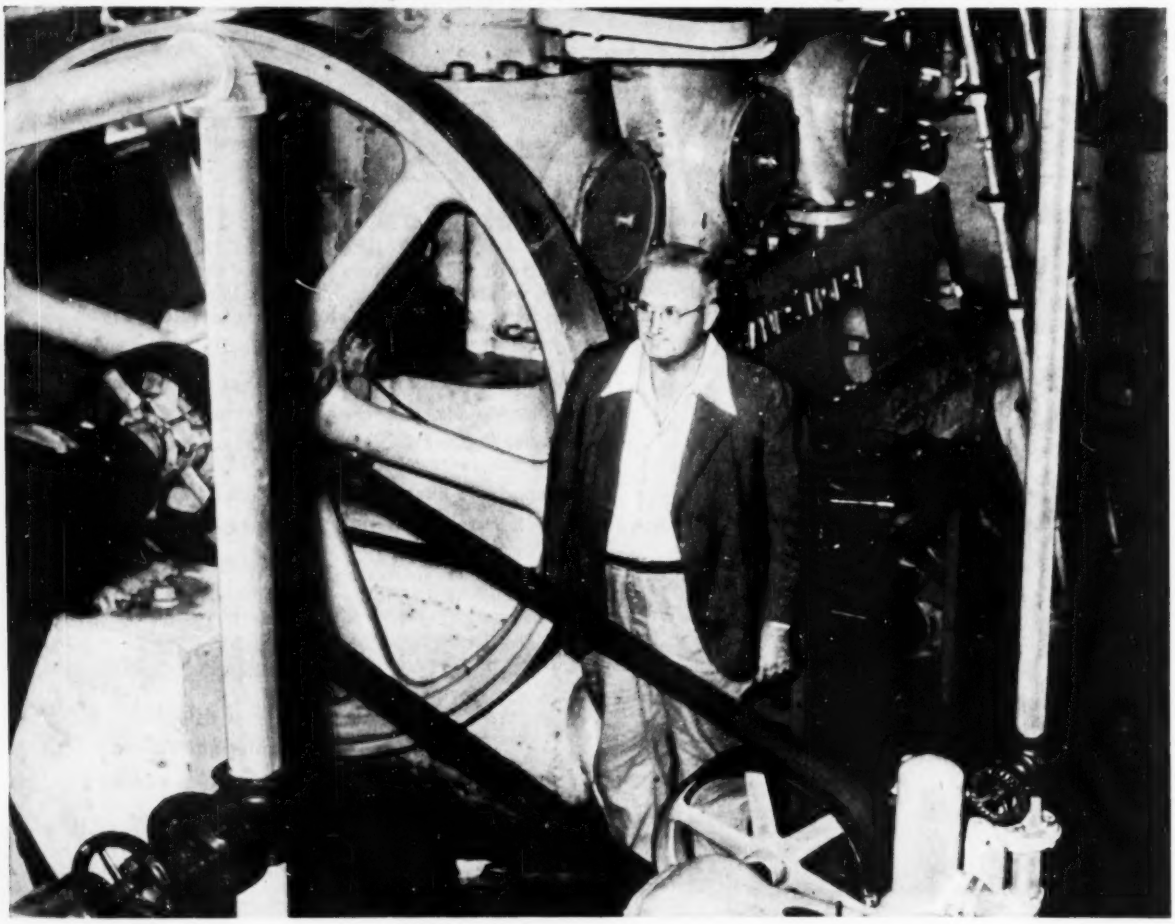
CHICAGO 13, ILL., 3819 N. Ashland Ave. • NEW YORK 17, N.Y., 231 E. 46th St.
LOS ANGELES 5, CAL., 1808 West 8th St. • TORONTO, ONT., 195 Spadina Ave.
MEXICO, D. F., Apartado 63 Bis.

AMD

60 Years of Temperature and Humidity Control

Dependable Diesel Power is a Must in The Everglades

...Says Bill Allen, South Florida Conservancy District



"We can't afford stuck rings or carbon here in the Lake Okeechobee area. From May through November, diesel pumps must handle an enormous rainfall — and dependable 24-hour operation is *essential* to the success of our crops."

Mr. Allen adds, "18 years ago, we changed to Sinclair GASCON Oil. It eliminated our problem of sticking rings and carbon deposits in the exhaust ports. We've used this product together with Sinclair Diesel Fuel exclusively for all these years. Our diesels thrive on this combination — we're more than satisfied with Sinclair."

Why don't you, too, change to GASCON® Oil? Give it the chance to help cut maintenance while adding dependability to your diesels. Contact your nearest Sinclair Representative or write Sinclair Refining Company, 600 Fifth Ave., New York 20, N.Y.

SINCLAIR DIESEL LUBRICANTS

IT COULD NEVER HAPPEN

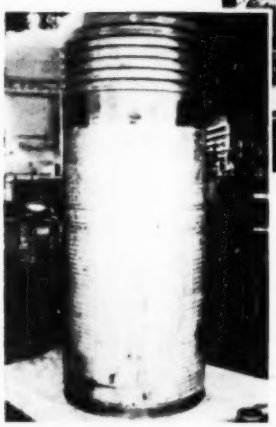
One character of the alphabet could never change the characteristics of aluminum! And though our October ad ran with the word "impedability" through a type error . . . the great **imbedability** characteristics of aluminum haven't been changed in the least.

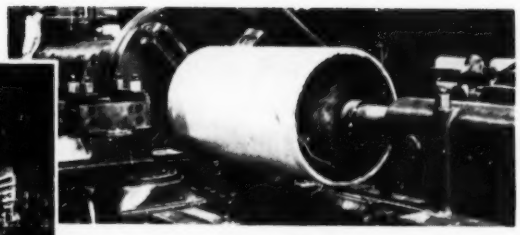
But we hope that you were not misled by this error . . . after the long years it took to accomplish ALUMIBONDING and abolish "impedability" forever!

Actually, ALUMIBONDING, a process that for the first time permits aluminum to be molecularly bonded to a cast iron or steel piston skirt, completely eliminates the problem of piston seizures—or "impedability"—because aluminum's **imbedability** characteristics allow hard particles to work down the skirt, thus avoiding serious damage to piston or to liner caused by interruption of lubricating film.

ALUMIBOND permits the production and design engineer to control all inherent piston problems, as well, providing a combination of the strength, resilience and fatigue resistance of ferrous units, with the heat transfer, bearing qualities, and corrosion resistant properties of aluminum.

So please do not be "impeded" by the sleight-of-type which caused the unfortunate error in our October ad. Write for the ALUMIBOND Booklet today and get the whole story on this great material advance!





Left—Alumibonded piston after one year's service. Scratches indicate where hard particles worked down the skirt with no serious damage to piston and none to liner . . . because of aluminum's imbedability characteristics.

Above—Cast iron piston skirt used in large 2-cycle diesel engine with Aluminum bonded to bearing surfaces by ALUMIBOND process. Since Aluminum has excellent bearing qualities, the entire skirt is virtually one large bearing.

If you operate a Diesel Plant . . .
we can bond a heavy aluminum bearing surface to the full length of your piston skirts by the Alumibond process . . . giving you far greater efficiency and maintenance economy.

If you manufacture original Diesel Equipment . . .
we can prepare your aluminum clad pistons in our foundry through the Alumibond process . . . giving your products far greater lasting power and built-in smoother operation.

GET THE WHOLE STORY!
Write For The ALUMIBOND Booklet TODAY!

ARTHUR TICKLE ENGINEERING WORKS
30 Delevan Street, Brooklyn 31, N. Y. Telephone: MAin 5-4200

FREE—
to designers,
engineers,
draftsmen

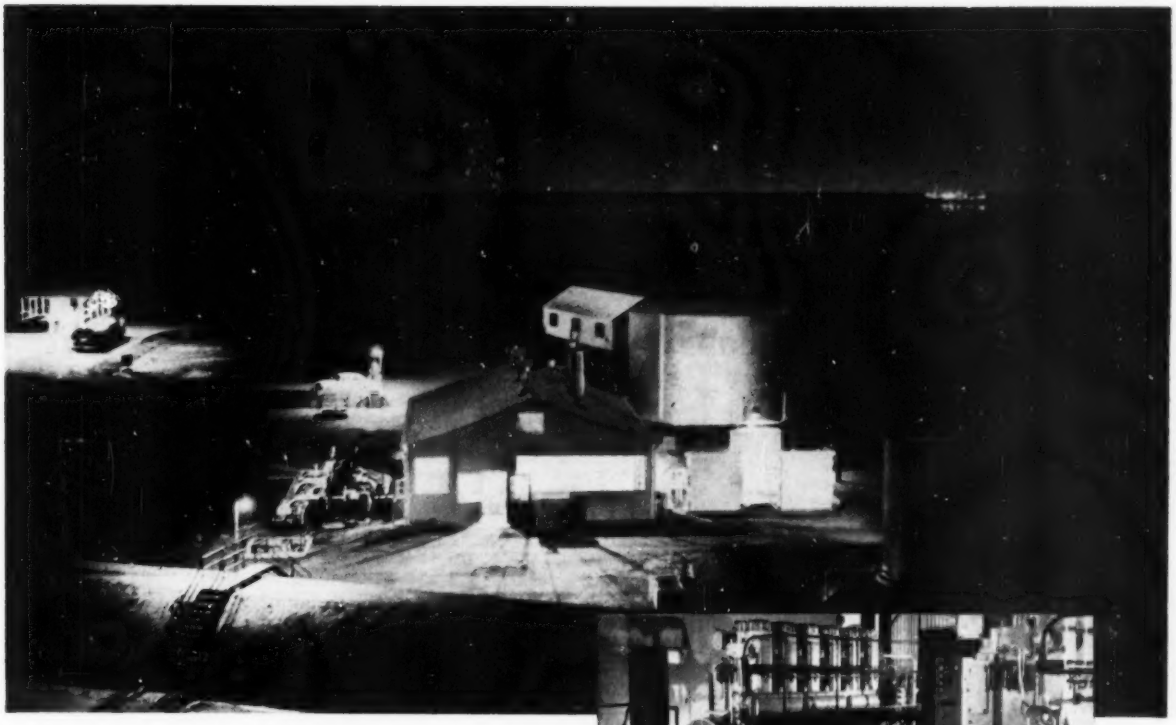
Have you been receiving your copy of "Sleeve Bearing Topics" . . . the convenient reference on materials, designs, new developments and applications of sleeve bearings, bushings and similar precision parts. We'll send back issues while still available. Your business letterhead request brings your copy . . . write today.

FEDERAL-MOGUL CORPORATION, 11041 SHOEMAKER, DETROIT 13, MICHIGAN

FEDERAL-MOGUL

SINCE 1899 FEDERAL Mogul

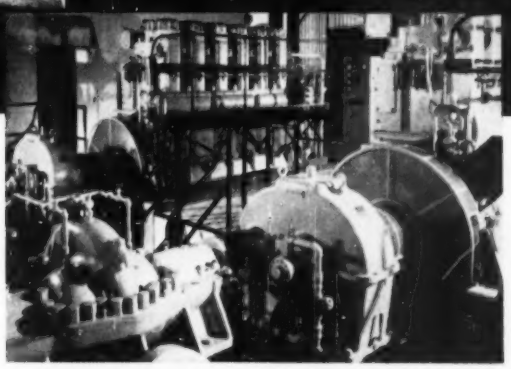
Products of our six plants include: Sleeve bearings in all designs and sizes; cast bronze bushings; rolled split-type bushings; bi-metal rolled bushings; washers; spacer tubes; precision bronze parts and bronze bars.



POWER—NIGHT OR DAY

ENTERPRISE Pipe Line Diesels cut tanker loading time and costs at Union Oil Ventura Pumping Station

Pumping crude from tanks to tankers calls for power that's ready when you need it—*night or day*. The intermittent use of power required for this fast moving operation demands *sure starting* and *continuous pumping* on *short notice*. The ability of these diesels to handle a fluctuating load increases pump efficiency and capacity. At Ventura, as with other similar ENTERPRISE installations, this means *more oil pumped faster* and shorter turn-around-time for the tankers. These important operating characteristics are not found in other pumping methods.



Two Enterprise DSG-6 Diesels, rated 465 HP at 450 RPM, furnish all the power for pumping an average 12,000 bbls. of crude per hour shore-to-ship, through 4,280 ft. of 20" cement coated line.

ECONOMY *PLUS* EFFICIENCY WITH ENTERPRISE DIESELS

- **Fuel flexibility**—Engines operate efficiently on standard diesel fuel, heavy fuel or dual-fuel.
- **Handle fluctuating loads** through a wide engine speed range for top pump efficiency regardless of viscosity changes.
- **Minimum plant investment**—more power in less floor space with compact ENTERPRISE power.
- **Low personnel requirements** for supervision, operation and maintenance.
- **Fully automatic operation**—wherever required or desired.
- **Remote location**—there are no power interruptions with ENTERPRISE Diesels.
- **Service and parts** are available within hours to the most remote locations.

Write for full details on the complete line of ENTERPRISE 4-cycle Diesel and Dual-Fuel engines, 68 to 2056 HF, turbocharged or normally aspirated.

Enterprise DEPENDABLE Diesels

ENTERPRISE ENGINE & MACHINERY CO.

A Subsidiary of General Metals Corporation

18th & FLORIDA STREETS, SAN FRANCISCO 10, CALIFORNIA

Boston • Chicago • Ft. Worth • Kansas City • Los Angeles • New Orleans
New York • San Diego • Seattle • St. Louis • Washington, D. C.

NOW IN USE ON 32 RAILROADS*

HUNT-SPILLER'S NEW AIR COMPRESSOR CYLINDERS

Made of
TOUGH, LONG-LASTING

GUN IRON

Since the introduction of HSGI Air Compressor Cylinders, less than a year ago, 32 of America's leading railroads have adopted this outstanding cylinder development for replacement in their diesel engines.

Why this selection of HSGI Air Compressor Cylinders?

ADVANCED DESIGN . . . . LONG-LASTING VALUE!

- ✓ Due to exceptional design refinements coupled with air furnace casting techniques—HSGI Air Compressor Cylinders now add approximately 42% more area to heat-radiating fins.
- ✓ Fin area is concentrated at the head-end of cylinders for greatest heat dissipation.
- ✓ Because of greater fin area, overall operating temperature is reduced.
- ✓ Long lasting value is provided due to Hunt-Spiller Gun Iron properties. The fine-grained, dense, pearlitic structure of HSGI cylinders means long life and even wearing qualities.

*NAMES ON REQUEST

For over 140 years, Hunt-Spiller has provided leadership in casting, engineering and manufacturing. Gun Iron Air Compressor Cylinders are just one of the advancements, found today in diesel engine parts, made possible by Hunt-Spiller.

If you have diesel parts subject to friction, heat, pressure or erosion—it will pay you to investigate the advantages of Hunt-Spiller Gun Iron.

HUNT-SPILLER GUN IRON • HSGI • AIR FURNACE PROCESS

HUNT • SPILLER

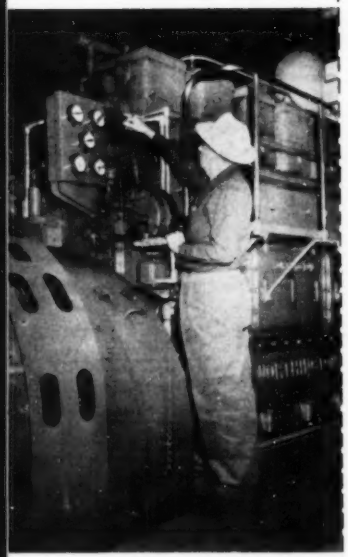
MANUFACTURING CORPORATION

373 DORCHESTER AVENUE • SOUTH BOSTON 27, MASS.

Canadian Representatives: Joseph Robb & Co., Ltd., 4050 Namur St., Montreal 16, P. Q.

WOODWARD

UG8 *Governors*



The operator above is adjusting the speed setting of a UG8 governor.

INSTALLED IN NASSAU COUNTY SEWAGE TREATMENT WORKS

Woodward UG8 governors are installed on engines at the recently completed Nassau County Sewage Treatment Works, East Rockaway, New York. The governor is normally isochronous, and will maintain the same engine speed regardless of variations in load. Speed droop adjustment for paralleling purposes and load limit adjustment are provided.

World's oldest and largest exclusive manufacturer of hydraulic governors for prime movers.

WOODWARD GOVERNOR COMPANY

ROCKFORD, ILLINOIS

Again... proved BEST!

Over-all engine wear REDUCED.....78%
Ring wear REDUCED.....33%
in over-the-road tests with

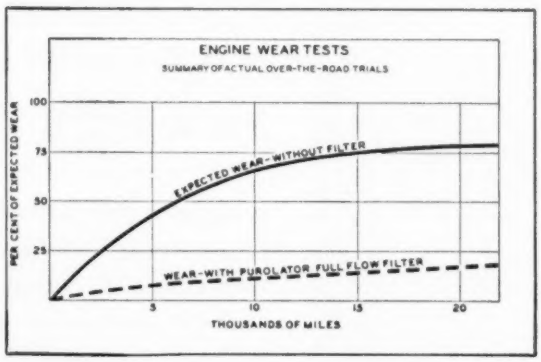
PUROLATOR

FULL-FLOW

MICRONIC FILTERS

In test after test, America's leading automotive and engine manufacturers are proving that Purolator oil filters are the best!

The figures you see above are from engineering records compiled by one of the world's largest makers of passenger cars and trucks. They are the results of gruelling *actual-service* tests made to compare the performance of various makes and types of lube oil filters. And, like so many other important ones, this manufacturer found that Purolator*, *and only Purolator*, oil filters gave them the engine-saving performance they were seeking. They found that Purolator Full-Flow filtration was better by far than *any* partial flow system . . . that the Purolator Micronic* Filter element gave finer filtration, with longer life, at lower pressures than any other tested.

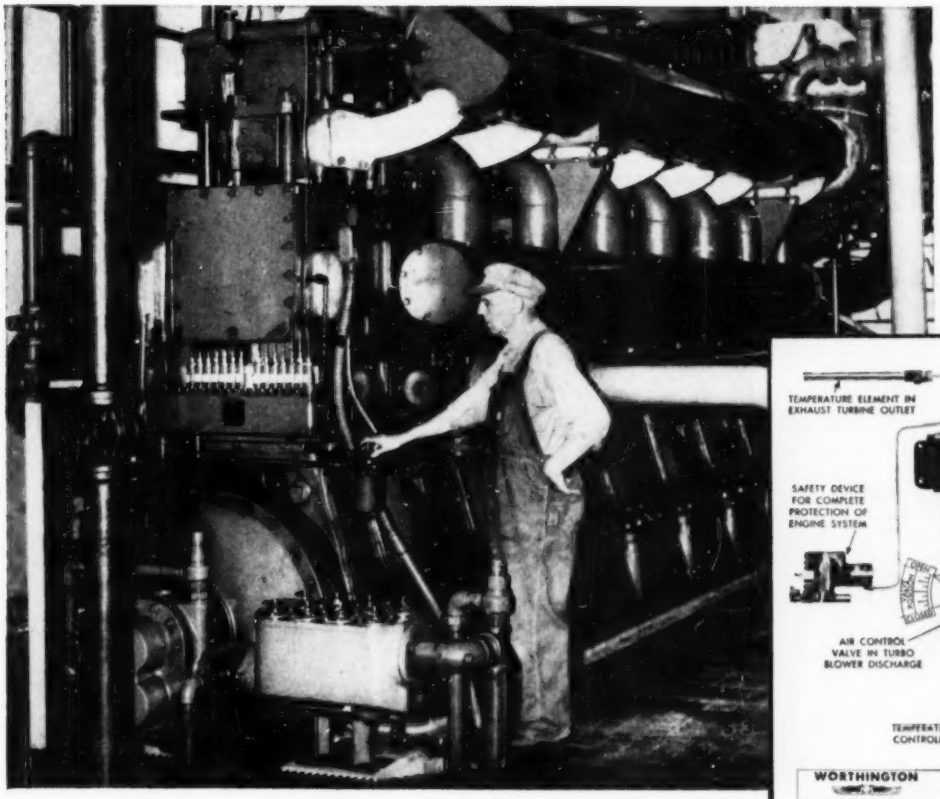


There are sound reasons for the Purolator Micronic Filter Element's outstanding superiority! It is the *only* element capable of delivering full-flow rates during its entire service life, *with dependable filtration down to submicrons* (.0000039 in.)! It has *ten times* the effective filtering area of old-style filters.

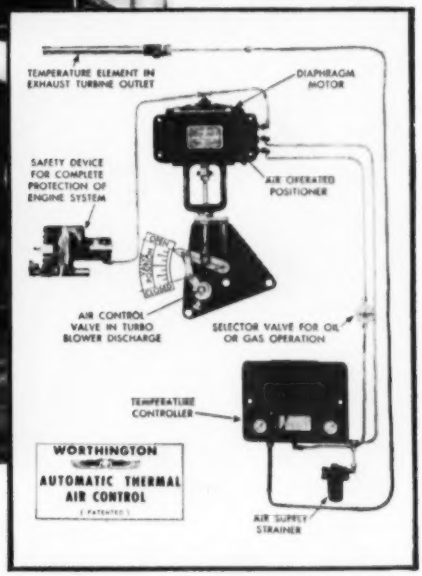
If you are a maker or user of internal combustion engines, you are invited to test and *compare* Purolator performance for yourself. Our Engineering Department will gladly co-operate in helping you prove to your own satisfaction *that there is no other oil filter capable of giving you better engine protection than Purolator. Simply write, telling us what equipment you are using.* *Reg. U. S. Pat. Off.

PUROLATOR PRODUCTS, INC.
Rahway, New Jersey and Toronto, Ontario, Canada
Factory Branch Offices:
Chicago, Detroit, Los Angeles

PUROLATOR
MICRONIC OIL FILTER
"FIRST IN THE FIELD OF FILTERING"



WORTHINGTON 1,000-KW CAPACITY SUPERCHARGED DUAL FUEL DIESEL with Worthington's Automatic Thermal Air Control, used in conjunction with municipal steam generating plant at David City, Nebraska.


TEMPERATURE ELEMENT IN EXHAUST TURBINE OUTLET
DIAPHRAGM MOTOR
SAFETY DEVICE FOR COMPLETE PROTECTION OF ENGINE SYSTEM
AIR OPERATED POSITIONER
AIR CONTROL VALVE IN TURBO BLOWER DISCHARGE
SELECTOR VALVE FOR OIL OR GAS OPERATION
TEMPERATURE CONTROLLER
WORTHINGTON
AUTOMATIC THERMAL AIR CONTROL
AIR SUPPLY STRAINER

Cost-per-kw down over 60% with Worthington Dual Fuel Engine

David City, Nebraska—this city has proof that the Worthington Dual Fuel Diesel can reduce power-plant operating costs.

Engineering of this installation—made in August, 1949—was under the direction of Black and Veatch, Kansas City, Mo., Consulting Engineers. At the present time the unit operates at only one-third capacity in supplementing steam power generation.

In spite of these poor load conditions, the David City plant's overall operating cost per kw was down 60% the first year this engine was used.

ONE BIG REASON YOU GET MORE EFFICIENCY FROM THIS ENGINE

Worthington's Automatic Thermal Air Control—an exclusive patented Worthington feature—is one of the biggest reasons you get more efficiency from this dual fuel engine—or from Worthington gas engines.

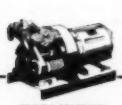
Unlike any air throttling mechanism dependent on governor action, this unit is actuated by engine exhaust temperature.

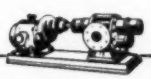
It maintains optimum air-fuel ratio at all times; provides automatic variation of air quantity in direct relation to ambient air temperatures; automatically compensates for changes in the heating values of the gas fuel (this would require manual adjustment where air-throttle controlled governor is used); maintains highest fuel economy at all loads regardless of changes in air temperature or fuel quality.

Worthington engines can increase *your* plant's efficiency and lower its operating costs. For more facts on Dual Fuel or other engines, gas or Diesel, write for bulletins to Worthington Corporation, Engine Division, Buffalo, N. Y.

E.3.1

Worthington-Built Auxiliaries


ENGINE STARTING COMPRESSORS


OIL TRANSFER PUMPS

COOLING WATER CIRCULATING PUMPS

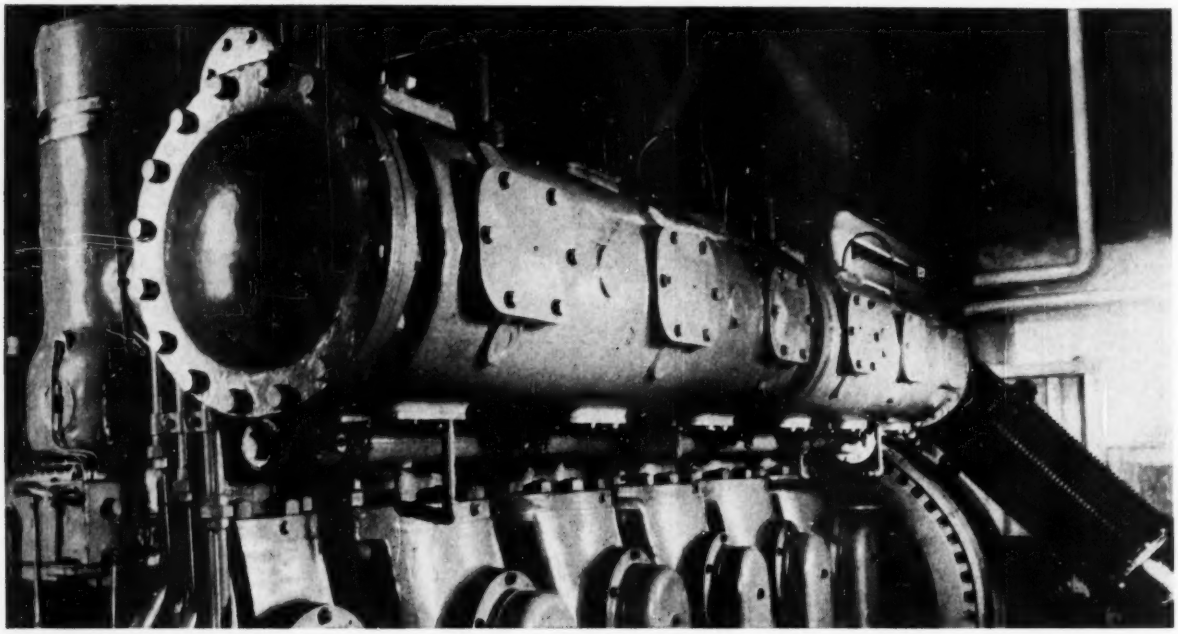
EVAPORATIVE-TYPE ENGINE WATER COOLERS

Economical Continuous Power—Diesel Engines, 150 to 2,100 hp . . . Gas Engines, 190 to 2,100 hp . . . Dual Fuel Engines, 345 to 2,100 hp.

WORTHINGTON
Engines

INCREASING THE LIFE SPAN

OF EXHAUST LINES



American Flexible Steel Exhaust Hose was specified for this 450-H.P. Fairbanks-Morse Diesel Engine at a power plant in Jasper, Alberta, Canada.

This American Flexible Steel Hose is specially made to take day-in, day-out grind of heat, vibration, stress, and fumes.

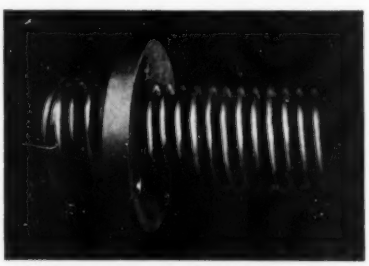
Repairs to diesel exhaust lines that have fatigued prematurely cost money. Engine down time due to flange bolts that have snapped is a dead loss. Replacing rigid pipes cracked by expansion takes time. It pays to consider carefully the life span of exhaust lines.

Check for flexibility and toughness. An exhaust line must stand up under vibration, pulsation, and extreme temperature variations for long periods of time.

Then check how easily the lines can be installed. Make sure it's gas-tight, and can "give" sufficiently with expansion and contraction to prevent broken castings and escaping gas fumes.

American Flexible Steel Exhaust and Air Intake Hose measures up to each of these exacting requirements. It is constructed of heavy corrugated flexible metal with flanges or fittings attached. It can easily be installed even where offset connections have to be matched. American Flexible Metal Hose adjusts to heat conditions and dampens vibration.

For original equipment or replacement, *specify* long-life *American Flexible Metal Hose* for Exhaust and Air Intake—also for your flexible line requirements for: starting air, circulating water, fuel oil, lubricating oil, etc. The American Brass Company, American Metal Hose Branch, Waterbury 20, Conn. In Canada: The Canadian Fairbanks-Morse Co., Ltd. 52270



American Corrugated Steel Exhaust Hose made in such popular sizes as 6", 8", 10" I.D. Flanges to A.S.A. standards or various Navy Specifications are attached at our plant.

Write for copy of new informative booklet EH-50. It contains dimensions, weights, recommendations on American Flexible Metal Hose for exhaust, air intake, fuel, air, water connections, etc.

wherever connectors must move . . .

American ANACONDA from mine to consumer **FLEXIBLE METAL HOSE AND TUBING**

"Tycol Adelbus cuts costly overhauls... Diesels give years of top service with negligible liner wear"

Exactly! Tycol Adelbus Diesel Oils are fortified with selected additives that provide a tough "film of protection," and help to eliminate sludge and varnish. They have excellent detergent-dispersive characteristics and amazing resistance to heat . . . assure the piston seal that means FULL power and economy . . . and provide exceptional resistance to oxidation.

Complete information about Tycol Adelbus Diesel Oils is available from your nearest Tide Water Associated office. Call or wire now.

TYCOL

INDUSTRIAL LUBRICANTS

Boston • Charlotte, N. C. • Pittsburgh
Philadelphia • Chicago • Detroit
Tulsa • Cleveland • San Francisco

TIDE WATER ASSOCIATED OIL COMPANY

17 BATTERY PLACE · NEW YORK 4, N. Y.

SEND FOR A FREE COPY OF "TIDE WATER ASSOCIATED LUBRICANIA"

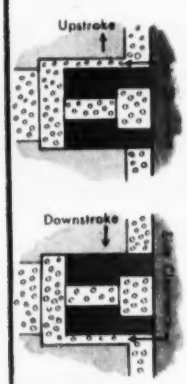
Stop ring "valving" action*

with

COOK "SUPER-FLEX" OIL CONTROL RINGS

TYPE 222-2X

***HOW RING "VALVING" ACTION OF ORDINARY RINGS CAUSES OIL PUMPING**



An ordinary oil control ring alternately acts as a valve plate against the upper and lower groove lands of the piston. On the upstroke of the piston, the ring seats on the lower land and the side clearance at the top fills with oil. On the piston's downstroke, the ring is seated against the top land and "squeezes" the oil out of the clearance past the ring. This "valving" action in an engine of average size and speed materially increases lub oil consumption.

● **COOK "SUPER-FLEX" OIL CONTROL RINGS are the new coil peripheral compression type expander rings—designed to provide trunk type pistons with far greater oil wiping efficiency than ever before. They are available in a wide variety of styles to meet many different oil control problems.**

The two-piece Type 222-2X "Super-Flex" Ring, for instance, prevents ring "valving" action. As shown above, the expander keeps the upper and lower ring members against the upper and lower piston lands, respectively—thus eliminating loss of oil through the side groove clearance—and at the same time maintains the desired unit pressure against the cylinder wall.

Write for full information and recommendations job-engineered to your specific operating conditions.

C. Lee Cook Mfg. Co., Incorporated, Louisville, Ky.
Representatives in principal industrial cities.

COOK
PISTON RINGS

. . . SEALING PRESSURES SINCE 1888 . . .

DIESEL POWER
AND DIESEL TRANSPORTATION

Brian P. Emerson, *Editor*

John H. Wetherell Jr., Associate Editor

Established in 1923

GEORGE R. BRIGHTON
President

JAMES E. JONES
Vice President & Treas.

G. RENFREW BRIGHTON
Vice President & Sec'y.

ARNOLD B. NEWELL
Vice President

ARTHUR N. GODING
Business Manager

HERBERT C. SPENCER
Circulation Mgr.

M. D. PUGH
Pacific Coast Manager
2721 North Marengo Ave.
Altadena, Calif.
Sycamore 7-2894

NEWSPAPER REPRESENTATIONS, LTD.
British Representative
231, Strand,
London, W. C. 2, England

Subscription Rates

	Single Copies	1 year	2 years	3 years
U. S.	35¢	$3.00	$5.00	$ 6.00
Canada	40¢	4.00	7.00	9.00
Foreign	40¢	5.00	8.00	11.00

Diesel Power & Diesel Transportation is indexed regularly by Engineering Index, Inc. and is available in microfilm editions from University Microfilms, Inc., Ann Arbor, Michigan.

November, 1952

Vol. 30, No. 11

Cover Photo: Not pretty perhaps, but a good example of how diesels are serving in all fields. It's a Whitcomb yard locomotive powered by a 3-cyl GM diesel.

EDITORIAL

Beware of Half-Truths 33

SPECIAL FEATURE

Roosa Master—A Fuel Injection Pump with Ideas 36
Preview of a fuel injection pump with some interesting design features.

ARTICLES

Dual-Fuel Economy for Sewage Disposal 40
Increased Power for B-L-H Locomotives 46
Diesels Power Tanker Loading Station 50
A Look at Combustion in Gas Engines 54
Dual-Fuel Engines Cut Costs 60
Care and Charging of Batteries, Part II 63

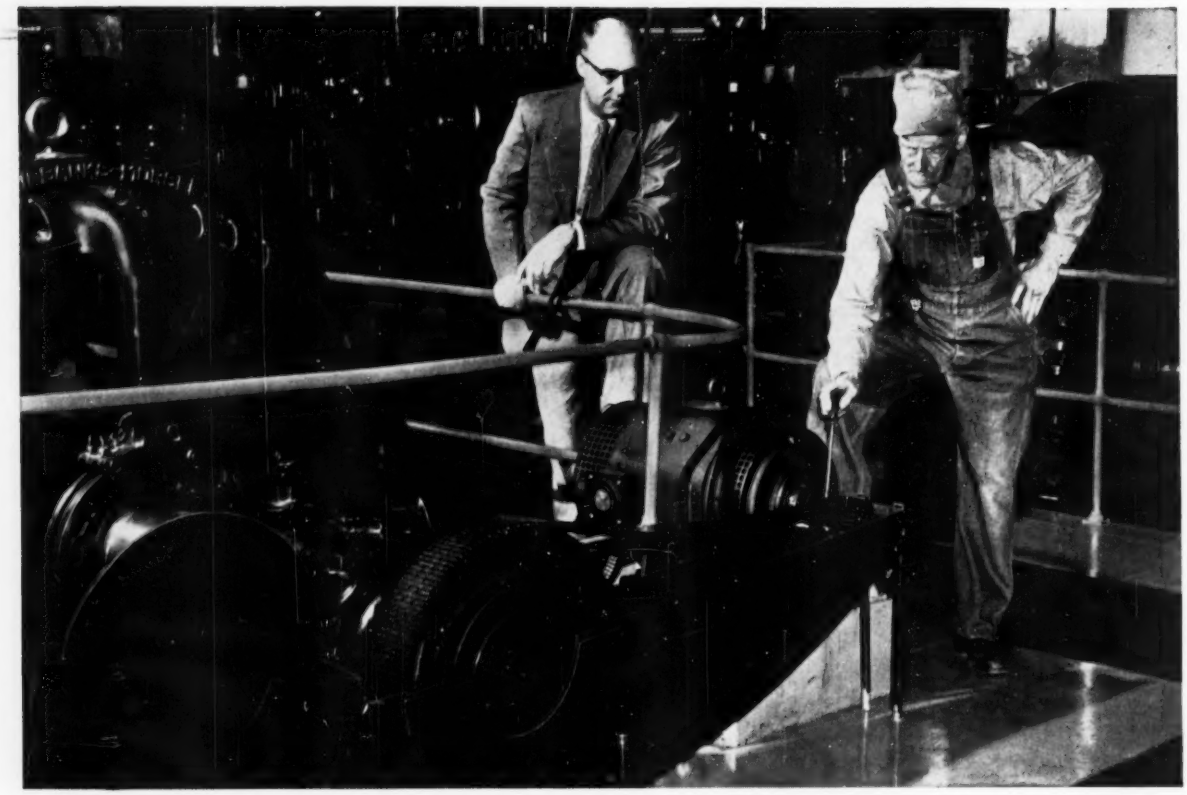
DEPARTMENTS

Highlights 35
What Do You Know! 45
Diesel Briefs 52
Straight from the Tool Box 66
New Products 68
Field Notes 78
Ad Index 90

Diesel Publications, Inc., 192 Lexington Avenue, New York 16, N. Y.

Diesel Power and Diesel Transportation is published monthly at Orange, Conn., by DIESEL PUBLICATIONS, INC., 192 Lexington Ave., New York 16, N. Y. Tel. Murray Hill 3-9874. Cable address: Dieselpub, N, Y. Subscription Prices: United States, $3.00 per year; Canada, $4.00; Foreign, $5.00. Single copies, United States, 35c. Bound volumes by previous year, $15. Subscribers are requested to send both the old and new addresses when ordering change in mailing.

Copyright, 1952, Diesel Publications, Inc.



Link-Belt Silent Chain Drive operates the exciter on this 840 kw Fairbanks-Morse generator in Kansas. Two other drives operate at 375 kw and 781 kw.

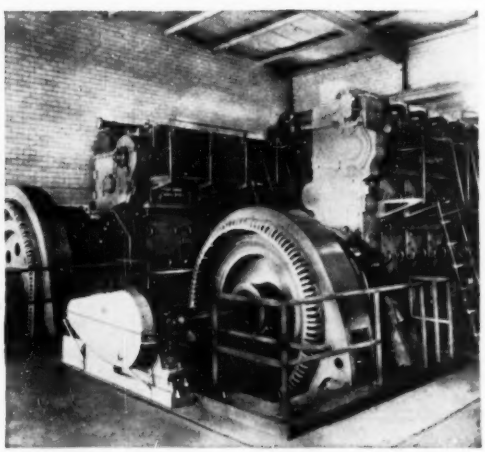
LINK-BELT Silent Chain Drives transmit full exciter rpm

Positive tooth-to-tooth action provides exact ratios for drives which give long, efficient service on diesel auxiliary drives

LINK-BELT Silverstreak Silent Chain does not rely on tension for its pulling power. The chain meshes with the sprocket teeth —gives you a positive drive—no slippage.

That's one big reason why so many diesel-generators have Link-Belt Silent Chain exciter drives. Another is its compact, all-metal construction. The long life of Silverstreak Silent Chain is a matter of record. Twenty-five years' service—with no maintenance other than routine lubrication—is regularly achieved.

If you're installing exciter or any other diesel auxiliary drives —check up on Link-Belt Silent Chain. There's an experienced power transmission engineer in the Link-Belt office near you.



At this Iowa station, the Link-Belt Silent Chain Exciter Drive transmits full rpm to a 1600 kw Elliot generator.

LINK-BELT

SILVERSTREAK SILENT CHAIN DRIVES

LINK-BELT COMPANY—Plants: Chicago, Indianapolis, Philadelphia, Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle, Toronto, Springs (South Africa), Sydney (Australia). Sales Offices in Principal Cities. 12,098

Editorially Speaking . . . .

Beware of Half-Truths

We got kinda mad at an article that we recently read in a popular magazine. It wasn't the first of its kind that we had come across, but it just served to bring our inward seething to the point of eruption into print.

Since these are popular magazines, they try to appeal to a large audience. In this case, it is the motoring public. Apparently, they go along the normal tenor of their ways until they "discover" some "chicanery" that is being perpetrated on this audience and feel impelled to "expose" it. It seems to be the "smart" thing to do.

Unfortunately, the principal means of discovery seems to be, running across an article which appeals to the Editor's crusading spirit. Usually, it will tend to prove that some vested interests are either seeking to deprive the motorist of some money-saving development or giving them improper information so as to sell more of their products.

Equally unfortunate, it would seem that the Editors, lacking the technical background to properly evaluate the articles, do not bother to have a qualified check made. They don't seem to realize that most of these authors have a big fat axe to grind.

The most recent article dealt with the subject of re-refined oil. It virtuously pointed out the wanton waste of only using oil once, and then discarding it. It extolled the excellent qualities of re-refined oils—not those that are properly handled, but *all*. It struck at the discriminatory practices required for labeling re-refined oils. In short, it was all a dastardly plot.

We have no doubt but that after the article was published, untold numbers of service station attendants got punched right in the nose and never knew what it was all about.

The fact of the matter is that it is as inaccurate to say, "Re-refined oils are all good," as to say, "All re-refined oils are bad." The truth lies somewhere in between and requires a lot of qualification. Actually, most large engines are running on re-refined oil. Either there is provision for continuous re-refining of a part of the flow, or it takes place during batch purification.

Another article appearing in a magazine, that is beyond reproach in the eyes of many people, was devoted to the premise that oil never wears out. Oil changes at 1000 miles were ridiculed. We will buy the idea that it doesn't wear out, but we will submit, it sure gets contaminated. Here again, we have a half-truth.

We remember another on the subject of storage batteries, and there have been others. The point is that only half the story, or a very "slanted" story, is told in each case. False impressions are implanted in the minds of a great number of people and long, expensive, educational programs negated.

Now, why are we upset about misinformation or wrong impressions given to the gasoline automotive field? First, most diesel users are also motorists. Next, some of the letters we have received, particularly from men concerned with automotive-type diesels, indicate doubts and confusion. The feeling seems to be, "If I am taking a rooking with my car, how do I know about my diesel?"

Perhaps we over-emphasize the impact of these irresponsible "half-true" articles, but we resent anything that adds to the sum-total of misinformation that is all too great as it is. All right then, what can these people believe and where do they turn for objective information? The trade papers, in every field, are the best bet. They treat their field of subjects continuously and objectively. Also, they have the necessary technical background to do the job.

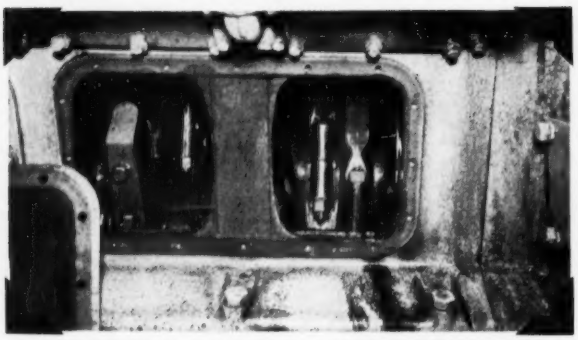
We will make a deal with these magazines. If they promise not to encroach on matters pertaining to our field, we promise not to be concerned with the dope racket, politics, or ladies' fashions. Is it a deal?

STANDARD ENGINEER'S REPORT

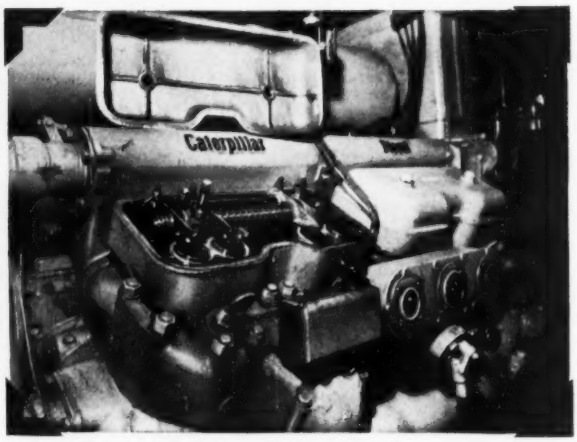
DATA

LUBRICANT	RPM Delo Oils
UNIT	Caterpillar D-375 diesel
SERVICE	Coastal fishing—bottom fish
CONDITIONS	Constant load
FIRM	A. Paladini, Inc. Fields Landing, Calif.

Heavy-duty engine clean after 4146 hours' work!

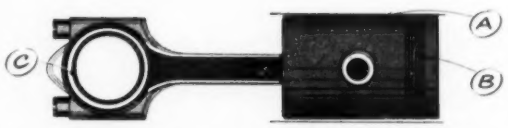


AFTER 4146 HOURS of steady work in the 270 H.P. supercharged diesel propulsion engine of the Catherine Paladini below, note how clean and free from deposits RPM DELO Supercharged—2 Lubricating Oil has kept parts. Crankcase drains and filter changes at 1500-hour intervals have shown no sludge, according to Axel Bjork, Skipper. He says, "The engine ran perfectly during the more than 4000 hours of tough work—if anything, it runs better now than at first."



THE 73-FOOT-LONG CATHERINE PALADINI has a 19.6 beam. She fishes from Oregon to San Francisco, bucks heavy seas and tides on trips that last from three days to over a week. Seas were exceptionally heavy during the past winter, giving her new engine an extra tough workout.

How RPM DELO Oils keep engines clean and prevent wear



A. Contain special additives that provide metal-adhesion qualities...keep oil on parts whether they are hot or cold, running or idle.

B. Anti-oxidant resists deterioration of oil and formation of lacquer...prevents ring-sticking. Detergent keeps parts clean, helps prevent scuffing.

C. Special compounds stop corrosion of any bearing metal, and oil foaming in both wet and dry sump engines.

There is an RPM DELO Oil to meet every heavy-duty engine operation condition.

FREE BOOKLET on the RPM DELO Oils gives you complete information. Write or ask for it today.

RPM DELO LUBRICATING OILS

TRADEMARK "RPM DELO" REG. U.S. PAT. OFF.

FOR MORE INFORMATION about this or other petroleum products of any kind, or the name of your nearest distributor handling them, write or call any of the companies listed below.

STANDARD OIL COMPANY OF CALIFORNIA
225 Bush Street • San Francisco 20, California

THE CALIFORNIA COMPANY
P. O. Box 780 • Denver 1, Colorado

STANDARD OIL COMPANY OF TEXAS
P. O. Box 862 • El Paso, Texas

+ HIGHLIGHTS +

● According to the American Association of Railroads, aggregate average tractive effort to this date shows: steam locomotives—59,799 lb, electric—66,410 lb, and diesel-electric—83,152 lb.

● San Francisco will play host to the Fifth Annual Pacific Automotive Show, which will be held in the Civic Auditorium on February 26 through March 1, 1953.

● More than 100 million manhours will be added to our productive effort this year as a result of the rehabilitation of physically handicapped men and women.

● Between September 1, 1945 and August 31, 1952, railroads purchased or erected 479,812 freight cars at an approximate cost of 2½ billion dollars.

● A recent report from the Chesapeake and Ohio Railway reveals that, for all practical purposes, it is dieselized, with the exception of coal originating areas.

● The U. S. Department of Commerce announced the availability of parts I and II of the Secretary of the Interior's annual report, dealing with Synthetic Liquid Fuels, from the Library of Congress.

● Recently, the Navy unveiled a new Jeep fire engine capable of delivering 1300 gal of foam per minute. It can operate for two minutes without being refilled. Its primary use is for fighting aircraft crash fires aboard carriers.

● No other nation in the world has a transportation system of the size of that in our country. Here are the rounded figures of this country's transportation facilities: over 27,000 miles of inland waterways; 227,000 miles of railroads; 3,300,000 miles of public roads; 150,000 miles of pipelines; and 40,000 miles of airways.

● Last year, more than 6000 miles of oil and gas pipelines were installed in the U. S.

● Statisticians of the Bureau of Public Roads in 1946 tried to estimate the number of cars that will be using the highways in 1960. By 1950 their estimates had been exceeded! Need more reason for improving our roads?

● It has been estimated that a horsepower hour produced by human muscles costs $10, and an animal hp hr costs 75¢. On a 13-cent, No. 2 fuel, a diesel hp hr will cost under 1¢.

● According to a recent survey conducted by the PAD, underground storage facilities for 5.9 million bbl of LPG will be available by the end of 1953.

● Plant Maintenance Show will be held at the Public Auditorium in Cleveland, January 19 to 22. Most major industries will have experts on hand to answer individual questions.

● The Baltimore and Ohio railroad recently opened a new 3300 ft tunnel through the West Virginia mountains.

● Mr. Verl E. McCoy, Chief Purchasing Officer of the Milwaukee Road, has been appointed Director of the NPA Railroad Equipment Division.

● Starting December, the British government and the Aluminum Co. of Canada will furnish this country with 77 million lb of aluminum. Reason for this is a power shortage in the Northwest and Tennessee Valley. What! This from "cheap and dependable" hydro power?

● The Young Presidents' Organization has elected R. D. Wasserman, president of Eutectic Welding Alloys Corp., to membership. To be a member, a man must have become president of a corporation doing a minimum business of $1 million gross, before reaching the age of 39.

● Every five seconds a freight train starts on its run somewhere in the U. S. A passenger train starts on its run somewhere in the U. S. every seven seconds.

● Today, our railway system handles about 60 per cent of the nation's freight commerce over the 225,000 miles of track in this country, and diesel-electric locomotives are pulling most of the load.

● Glacier Metal Co., Ltd., Middlesex, England, recently introduced a new centrifugal oil filter designed for use on high-speed engines.

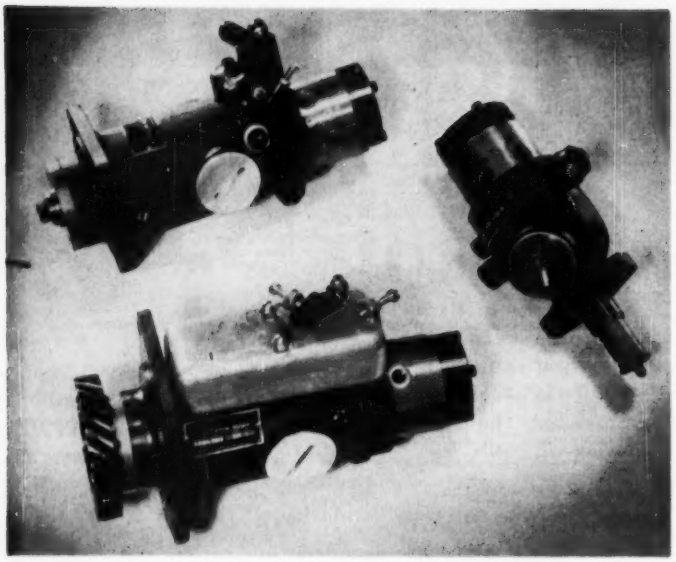
● A manpower shortage is developing in New York City, the New York State Department of Labor reports; and it will continue to grow worse if business continues at present high levels.

● Oil and Gas industries set their 1953 goal at 55,000 new wells to be drilled and 44,600 miles of oil and gas pipelines.

● Industry is spending some $25 million annually on scholarships and grant-in-aid at universities.

● Two hundred European workers are learning American production know-how in plants throughout the U. S. Brought here by the MSA under the Marshall Plan, they will soon be joined by 1800 others. Two of them are working at Worthington's Harrison plant.

● Raw materials deficit in the U. S. is illustrated by the following comparisons: In 1900, the U. S. produced 15 per cent more raw materials than it consumed; in 1950, the U. S. produced 9 per cent less than it needed. Assuming that our gross national product increases only at the same three per cent compounded every year in the last century, by 1975, raw materials output will fall 20 per cent short.



Three models of the new pump with three different type drives and three methods of governing. Top left is automotive unit; below is industrial model; and at right, is distributor-mounted unit for external governor control.

Here, for the first time anywhere, is a description of an important new development in the field of fuel injection equipment. It is the new fuel injection pump—new in concept, new in execution—developed and currently being built by the Hartford Machine Screw Company.

ROOSA MASTER

A Fuel Injection Pump with Ideas

"WHY didn't I think of that?" This is the immediate reaction upon seeing the Roosa-Master fuel injection pump and having its features and operation explained to you. It is an extremely simple mechanism but as is so often the case, its simplicity is deceptive; a lot of hard work and good engineering went into its development.

The idea for the pump dates back to 1939 and originated in the mind of the man for whom the pump is named, Vernon Roosa. A prototype went into service in September, 1940 and after operating successfully for over 14,000 hours at varying engine speeds up to 2000 rpm, was taken out of service.

Motivation behind the design was a feeling that a pump could be produced that was functionally efficient, but simpler and more compact than existing types, and so worked out as to cut manufacturing costs to a minimum. The cost of fuel injection equipment in relation to total engine cost was recognized as a major and longstanding stumbling block in the patch of expansion in the small diesel engine field.

In the design approach it was recognized that manufacturing costs, in general, are largely represented by the number of complex shapes that must be reproduced with great accuracy and the number of extremely close (lapped) fits. Therefore, the answer was to reduce the items in each category.

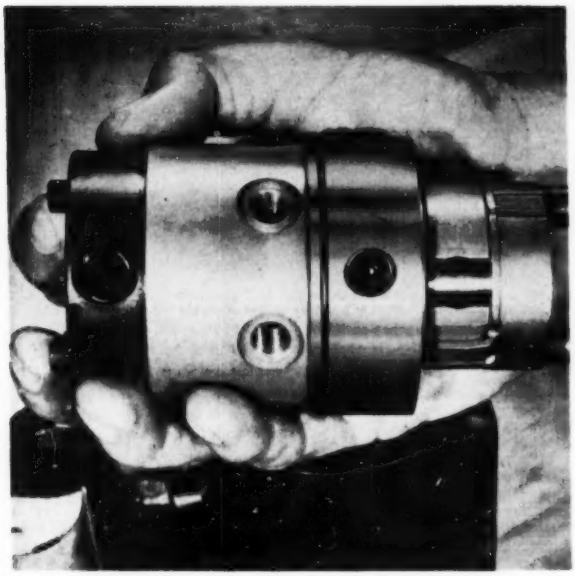
A newly conceived method of metering was one of the biggest factors in achieving the desired objectives. Distributor-type operation also helped, particularly in reducing the number of precisely fitted parts. The result was a simple unit with very few moving parts and only three critical fits, the rest being satisfactory if held to good commercial tolerances.

These pumps are now being built for application to both 4- and 6-cylinder engines. However, the design lends itself for application to 2-, 3-, 4-, 6- and 8-cylinder, both 2- and 4-cycle. The maximum output of the current models is approximately 115 mm^3 per plunger stroke and this makes them suitable for use on normally-aspirated engines of up to about 115 cubic inch displacement per cylinder.

A Look at Externals

Maximum flexibility with respect to mountings was envisioned in the design—both for the convenience of the engine designer and to permit interchange with existing pumps. Thus, in addition to the conventional side, bottom and flange mountings, there is something brand new in the fuel injection field—an ignition distributor type of mounting.

Manufacturers of both gasoline and diesel engines will undoubtedly find this an attractive feature. In addition to the relative simplicity and inexpensiveness of this type drive and mounting, it will permit the use of a single heavy duty engine block design for incorporation in engines of either type.



Heart of the unit makes a convenient handful. Left to right are transfer pump, hydraulic head containing metering mechanism, and pumping end of the rotor extending from the bore of hydraulic head. Driving plate (far right) clamps retaining plate to the rotor. Retaining plate is only pump adjustment—a maximum fuel stop.

The shape of the housing, then, will depend on the type of mounting. It will also vary with the type of speed control, a matter for later discussion. The relative sizes are apparent from the illustrations and weights will vary from about 8 pounds for the simplest execution to 18 pounds for the largest unit with integral governor.

Now, for the Internals

Inside the pump housing are the pumping and metering elements, plus the drive and in some models, a mechanical governor. The metering and pumping mechanism comprises five major parts. It will be helpful in understanding the functions of the pumps as these are enumerated and described briefly. Each can readily be seen and identified in the accompanying exploded view.

Transfer Pump—A 4-vane positive displacement pump supplies fuel to the metering device at an even and predetermined pressure. The shape of the pumping cavity has been modified from the usual crescent shape to provide an almost constant flow and a spring-loaded by-pass valve controls the pressure.

Hydraulic Head—This unit houses the metering mechanism, contains the bulk of the oil passages and mounts the outlet fittings. The rotor shaft is closely-fitted to its central bore.

Rotor—This is the major rotating assembly. It contains bored fuel oil passages and in its drive end mounts the plungers. Its other end drives the rotor of the transfer pump.

Plungers—The drive-end of the rotor is larger in diameter than the shaft portion fitting in the hydraulic head. The plungers are closely fitted in a bore perpendicular to the shaft axis. They are actuated by shoes and rollers bearing on the cam ring.

Cam Ring—A stationary, internal cam ring is located in the housing. As the entire rotor (incorporating the plungers) turns in the hydraulic head, opposing lobes in the cam ring simultaneously force the plungers inward or allow them to move outward as the rollers ride down the lobes of the cams.

A clearer picture of these parts, their functions, and their interrelation will be obtained when the details of operation are discussed. Before that, there are some design features of interest that should be mentioned.

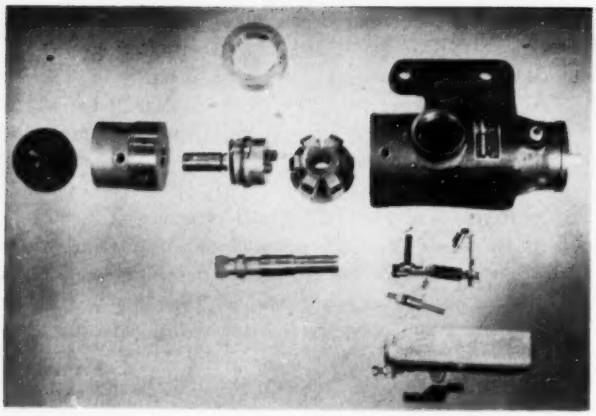
The variations in drives have been mentioned. They all have simple drives; some have sleeve bearings and all are free from complicated gears and ball bearings. The entire pump is self-lubricated, the filtered fuel being used as a lubricant. A small passage from the annulus in the rotor shaft allows the pressurized fuel to enter the housing, filling it completely. When the mechanical governor is incorporated in the units, all the parts are in filtered fuel oil.

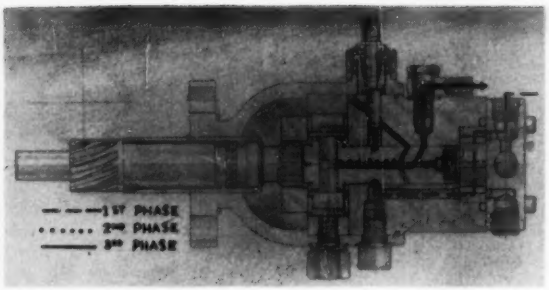
It is well known that elimination of air from the system is one of the major problems in fuel injection. The Roosa-Master has overcome this problem very satisfactorily. When air enters through the transfer pump, it follows the fuel as far as the annulus of the rotor. There a slot is milled along the axis of the rotor leading to a reduced diameter which allows the air to escape to the housing where it seeks its way along the shaft to the return line then back to the fuel tank. In the case of the industrial model higher pressure exists in the top of the pump under the cover due to the centrifugal action of the flyweights. Air trapped in this region will be forced down a small vent tube on the governor arm and released at a point close to the shaft. The air then will travel along the shaft and out the return line.

Since the supply pressure would be excessive, a return line from the pump to the fuel supply is provided. A predetermined quantity of fuel is returned to the fuel supply every hour which provides cooling for the pump. Sufficient restriction is placed in this line to insure a slight positive pressure in the pump. This insures penetration into the bearings and at the same time discourages the entry of dirt. Oil seals control leakage from the unit.

The simplicity of the entire mechanism is apparent and also the fact that no provision is made for adjustment or calibration. As a matter of fact, there is one adjustment—a maximum fuel or smoke stop. The entire mechanism is typical of the simple, functional design of the pump.

The outer ends of the plungers bear on very simple shoes sliding in guide slots in the rotor. The outer portion of the shoes are rounded out to accommodate the rollers. There are no pins, springs, bores or fits to worry about. The ends of the shoes have an ear on them and these





Above, Phase 1 shows transfer pump delivery to metering valve; Phase 2, delivery to pumping chamber; and Phase 3, high pressure delivery to nozzle lines.

Exploded view of industrial model. At left is housing, with cover and governor linkage above. In line with housing bore (from left) are governor flyweights, rotor, hydraulic head, and transfer pump. Cam ring is seen below, and the drive shaft above.

engage in eccentric radii in the retainer plates, one of which is locked between the rotor and the drive plate and the other spaced between the rotor flange and the hydraulic head.

Rotation of the retainer plates changes the distance from the axis of the shaft so that the ears on the shoes may move in or out before coming in contact with radii of the retainer plates. This limits the outward stroke of the plungers and hence the total amount of fuel that can be delivered per stroke.

These are the high points of the internal parts with the exception of the speed control mechanism and these will be discussed separately.

How Does It Work?

Let us follow the fuel through the pump with reference to the illustrations. Filtered fuel enters the transfer pump, is pressurized, and is discharged through a passage to the annulus cut in the rotor shaft. It can then travel around the rotor shaft to the metering valve.

From the metering valve, the fuel passes through one of the charging ports of the distributor rotor when that port comes into register with the metering valve port. The fuel forces the plungers outward in proportion to the quantity to be injected on the following stroke. It should be noted that all the fuel entering the pump cylinder is injected into the engine on the following stroke of the pump plungers.

As the rotor rotates the charging port passes out of register with the metering valve port and the fuel is momentarily trapped. A discharge port connecting to the central passage in the rotor shaft registers with an outlet passage. Then the plungers will start toward each other as the rollers ride up the cams forcing the fuel from the hydraulic head to the high pressure line running to the nozzle of one cylinder.

The timing and sequence of these functions are automatic as the ports, passages, etc., are located dimensionally during manufacture. Thus, moving parts are held to a minimum.

The metering system of the pump is simple and positive. It is just this, the metering valve controls the opening of a port that allows oil to flow to the rotor. The metering valve is installed in the hydraulic system between two pumps which are

1. a positive displacement vane type pump
2. a variable stroke positive displacement piston pump

It is obvious then that since the metering valve is on the inlet side of the positive displacement piston pump, the piston pump does not draw fuel through the metering valve but rather the vane type pump forces oil thru it at a rate that is controlled by the area of the port opening at the metering valve, the pressure of the vane pump, and the time that is available when the inlet port in the rotor lines up with the passage from the metering valve.

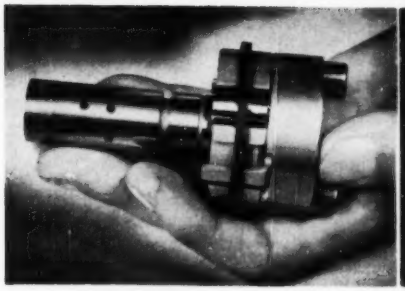
During this time the positive displacement plungers are forced apart by the action of the oil until, if time, areas and pressure permit, the plungers reach their full outward position being mechanically controlled by the above discussed retainer plate adjustment. If they do not reach the outward position, this will be a part load condition. The plungers only move outward as forced by the fuel from the vane pump through the metering valve and this occurs when the cam rollers are on the low section of the cam.

Further rotation of the rotor lines up the rotor discharge hole with a head outlet hole, and then the rollers start up the cam lobes forcing the oil out to the nozzle through the outlet fitting and nozzle line.

Three types of metering valves are used. The first is used in conjunction with the distributor type mounted unit wherein an external governor is used and second, the "automotive type" which incorporates its own governor spring. Third, the "industrial model", having its own mechanical governor, utilizes a slightly different mechanism. The effect remains the same in all cases.

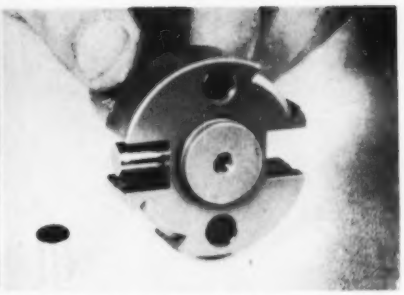
In the first model mentioned, the pressurized fuel acts against the metering valve to move it into the open position uncovering the port of the charging pasage. The pump will inject oil and accelerate the engine until the flyweights of the engine governor overcome the tension of the spring and cause the linkage to slide the metering valve against the pump pressure and restrict the flow of fuel thru the port of the charging passage.

The second or automotive type governor has its own governor spring which when loaded by the throttle mechanism causes the metering valve to slide and uncover the



Rotor assembly with plungers, shoes and rollers retained by rubber band. Note, right to left on shaft, annulus, fuel inlet passages and discharge hole.

Transfer pump showing vaned rotor and shape of pumping cavity. Outer contour is modified from true crescent to provide more constant volume delivery.



Pumping end of rotor with drive and retaining plate removed. One plunger, another in foreground, is extending into crosshead slot for shoe and roller.

port of the charging passage. The port will remain open until engine speed accelerates causing the transfer pump to build up pressure and finally slide the metering valve against the governor spring force and restrict the flow of fuel thru the port of the charging passage.

In the industrial models the amount of flow is controlled through governor action acting on a rotating metering valve. A slot in the valve is positioned so as to vary the area of the port. As before, the fuel will flow as the passages line up and the quantity will be a function of the size of the aperture.

Rate of delivery is a function of the cam contour and timing is dimensionally inherent. Just beyond the point of maximum cam lift and while the discharge passages are still in register, a slight drop in the cam retracts the plungers. This minute motion is sufficient to relieve the pressure in the line after the fashion of delivery valves in conventional pumps. This permits a sharp closing of the nozzle and reduces any tendency to dribble.

The entire cycle is repetitive as the rotor turns. The nozzle of each cylinder is connected to the outlet fitting on the hydraulic head in firing-order sequence.

Maintaining Speed Control

It should be clear by now that there are three basic methods used to control speeds. In the first case where an external governor is used, it is impossible to give any characteristics of the control; this will depend on the type of governor. It can be said that due to simple, direct action, the pump is sensitive and responsive.

In the automotive models, throttle linkage is used to vary the tension on a governing spring. The pressure exterted on the metering valve for any given setting determines the amount of fuel delivered. The simple control mechanism has minimum (idle) and maximum fuel stops. Speed control at any given setting will be in the order of 6 to 10 per cent.

Much more accurate control is achieved by the mechanical governor incorporated in the industrial models. Speed settings can be maintained within one per cent. The same rigorous fuctionalism that typifies the pump design is apparent in the governor. It is simple, sensitive, and designed for inexpensive production.

The flyweights, for example, pivot on their own knife-edge corners which bear on a plate, part of the governor weight retainer assembly. There are no holes to be drilled, pins, or fits to worry about and friction is held to a minimum. Motion of the weights is transmitted to a non-rotating sliding sleeve. This tends to distribute the force from the weights evenly around the face of the sleeve. A stamped governor arm transmits the sleeve motion by governor spring linkage to the metering valve. Motion of this arm and hence the flyweights is opposed by the governor spring.

There is a notable absence of complicated linkages, toggles, etc., that all contribute to the friction load. This tends to improve sensitivity. The method of damping to avoid rapid and wide fluctuations is rather unique. It has been mentioned that the housing is filled with fuel oil. The arm mentioned above has a broad area which resists rapid movement in the oil.

Positive shut-down of the engine is assured by a solenoid which, when operated, rotates the metering valve against a yieldable linkage to shut off the fuel delivery. This solenoid like the other mechanism is immersed in the fuel oil.

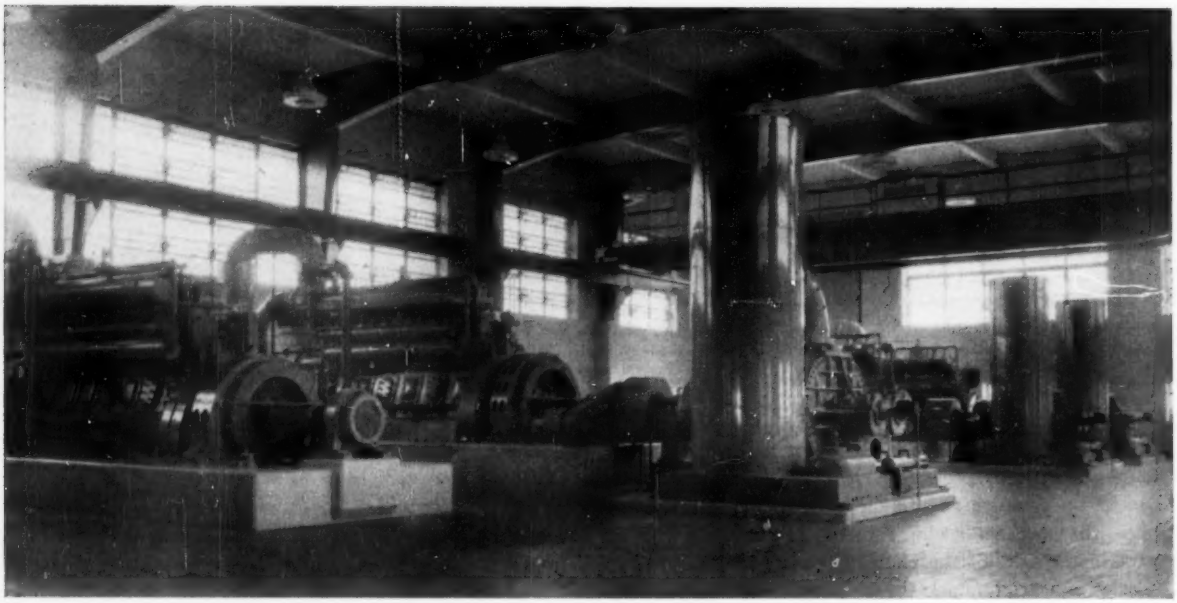
While discussing governing it is noteworthy that the pump design provides a certain degree of inherent self-compensation. This is similar, in effect, to that found in commonrail fuel injection systems. The reason in both cases is that whenever fixed sized orifices and passages are used, "time" becomes a factor.

For example, at a given speed setting, a certain amount of fuel must flow through through the metering port during the period that the passages in the hydraulic head and rotor are in register. These will be interconnecting for a certain number of degrees of crankshaft angular travel regardless of the engine rpm. However, the actual "time" available for fuel flow is dependent on the rpm.

Assume that the engine is running at its rated speed and that suddenly, additional load is applied. The engine will slow slightly before the speed-sensitive governor is aware that anything is wrong and moves to correct it. In the interim some self-compensation takes place.

At the rated speed, a certain amount of fuel will be flowing during the time that the metering valve, the register of the passages and the engine rpm allow. The engine slows

(Concluded on page 33)



View of the engine-generator-blower room showing four of the five turbocharged dual-fuel engines which are connected to blowers or generators. Second engine from the left drives either blower or generator through a special coupling.

Dual-Fuel Economy for Sewage Disposal

*By W. L. Kaehrle**

Sewage disposal is a problem which must eventually be faced by all communities of any size. High rate, activated sludge treatment is increasing in favor. The process requires power and since sewage gas is a by-product, the use of dual-fuel engines burning this gas is logical. Here is the first plant of this type to be erected in the county of Nassau, New York.

Preliminary studies and surveys for Nassau's sewage treatment works were started over 10 years ago with the county retaining the firm of Greeley & Hansen, recognized experts in sewage treatment and disposal. Tentative plans and specifications were prepared with R. H. Gould, Director, Bureau of Sewage, City of New York, acting as an advisory consultant to the county, because of his considerable experience with the sewage disposal program for the city of New York.

On April 4, 1949, formal plans and specifications were issued for bids on the construction, work being divided into seven separate contracts. Awards were made shortly thereafter.

In the following paragraphs, we will discuss principally the engines as the details of high rate activated sludge treatment have been published previously in this magazine. In view of this, we believe it will suffice to state here that in treating sewage with this method, air under pressure and heat are required as well as electrical power.

Here is where the dual-fuel engine has found a good application, since when the sludge is digested, gas is released. This gas, called sewage sludge gas, contains roughly 65 per cent methane (CH_4), with the balance principally carbon dioxide (CO_2). It is an excellent fuel for use in dual-fuel engines as no treatment is necessary.

When using engines of this type, power is available for dead plant starting. Power is also available at all other times, regardless of seasonal shortages, since the engines are capable of operating on either 100 per cent oil or any proportions of gas and 6 per cent pilot oil.

Power Plan

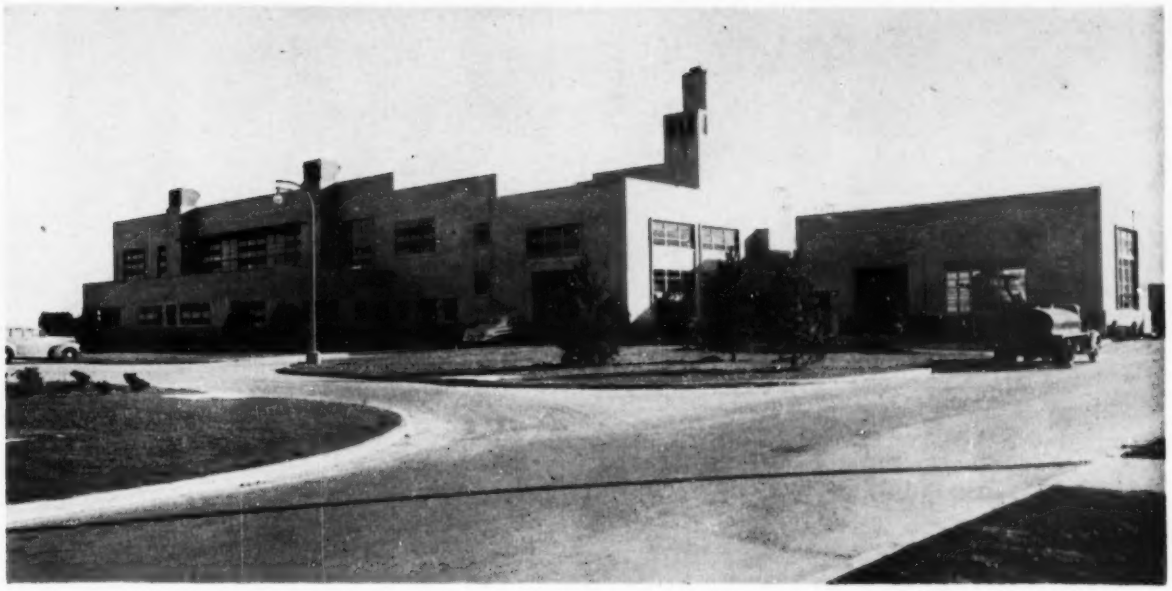
This modern two-story structure houses the generators, blowers, their prime movers, and other various equipment. First floor space is occupied mostly by five turbocharged dual-fuel engine generator and blower units, which supply all the power for plant operation. Remaining floor space is occupied by the electrical control room, machine shop, garage, sludge loading facilities, laboratory, lunch room, office, and supply rooms.

With pump and engine-generator-blower rooms extending through the second floor, remaining space here is taken up by the vacuum filter and air filter rooms.

Located in the basement are the pump room, boiler room, and engine and blower auxiliary equipment. Basement headroom is 15 ft, providing ample space for the waste heat boiler, blower air intake air silencers, all tanks, etc. This enables the main floor to be kept clear.

As the basement was designed with this high headroom, engine foundations were not carried to the floor as a solid block. Foundations are constructed with several 3 ft by 3 ft square columns resting on a lower slab (2 ft thick) supporting the solid upper block, which is of 6 ft minimum

*Engine Specialist, Eastern Engine Division
Worthington Corporation, New York City, N. Y.



This exterior view will lay at rest any thoughts of sewage treatment plants being an eyesore in a community. Also, when using this process, no odors are given off from the outside of the plant.

depth. This design affords adequate mass, utmost rigidity, and provides additional space in the blocks for the installation of engine and blower auxiliaries.

Engine Features

To provide flexibility and adequate standby, since there are no outside power connections, five dual-fuel engines are installed in the power plant with provision made for a sixth. Two engines drive generators, furnishing power for all of the electrically operated equipment. Two other engines drive positive displacement type blowers, supplying air required in the aeration tanks. The remaining engine serves a two fold purpose by driving either a generator or blower as needed.

Designation, ratings and capacities of the foregoing units are as follows:

Unit 1—Worthington Model SCCGO-6 engine, rated 615 hp at 514 rpm, direct connected to a 625-kwa, 500-kw at 0.8 P.F., engine type AC generator with a 7½-kw, 125-v, direct connected exciter.

Unit 2—Worthington Model SCCGO-7 engine, rated 720 hp at 514 rpm, direct connected to a 625-kva, 500-kw at 0.8 P.F., engine type AC generator with a 7½-kw, 125-v, direct connected exciter.

Unit 3—Worthington Model SDDGO-6 engine, rated 790 hp at 360 rpm, direct connected to a 625-kva, 500-kw at 0.8 P.F., engine type AC generator with a 15-kw, 125-v, 1150-rpm, Multi-V-Belt driven exciter, and connected by a special flexible coupling to a 32 by 35½ type RCDH blower having a capacity of 16,000 cfm.

Unit 4—This is to be a future unit similar to Unit 3 above.

Units 5 and 6—Worthington Model SCCGO-5 engine, rated 400 hp at 400 rpm, direct connected through flexible coupling to a 26 by 27½ type RCDH blower having a capacity of 8500 cfm.

All engines are of the turbocharged four-cycle dual-fuel type and of the numerous design features found on these engines, the following are worthy of special mention: individual dual-plunger fuel injection pumps; automatic thermal air throttling control; micro-metering gas valves—all of which contribute to better operating performance and maximum fuel economy.

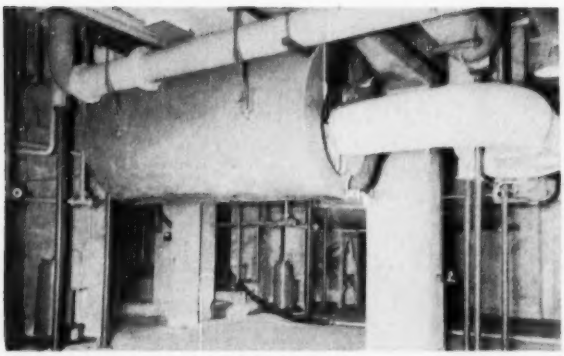
Dual Plunger Injection Pumps—Since these engines require a small amount of pilot oil when operating on gaseous fuels, provision must be made to accurately meter and inject this charge into the cylinder at the proper time. Also, provision must be made for injecting the amount of fuel required full load when the engine is operating on diesel fuel alone. On most engines, this is accomplished by using two injection pumps—one for pilot oil and one for the main fuel charge. However, on these engines both operations are performed by one dual-plunger pump.

The pilot plunger is mounted above, and actuated by, the main plunger. When operating on gas, the fuel rack is at the no-load position and the pilot plunger only delivers the fuel. However, when the engine is running on fuel oil only, both the main and pilot plungers deliver fuel to the common injector.

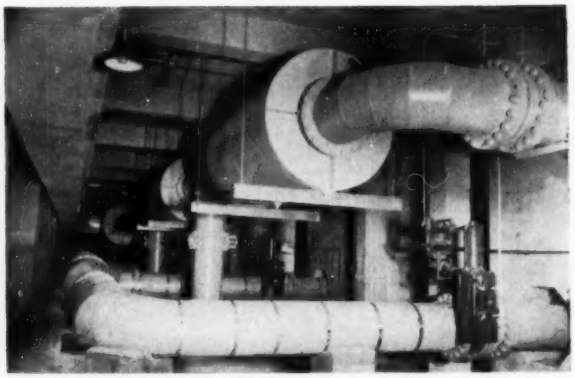
Pilot plungers deliver the same amount of fuel at all times, while delivery of the main plunger is varied. Therefore, when operating in ranges where more than just a pilot charge of fuel oil is required, the total fuel delivered is that of both plungers.

It is noteworthy that the capacity of the pilot plunger is less than the amount of fuel required to maintain rated engine speed at no-load.

Automatic Thermal Air Throttling Control—Extensive research has shown that unlike the diesel, dual-fuel engines will not run efficiently at all loads with the intake wide open. Therefore, intake air must be controlled by



Maxim waste heat boiler-silencers are hung from the basement ceiling. In background, other engine accessories can be seen mounted in the rectangular openings in the engine foundations.



Blower air intake and discharge lines, showing inlet silencers and automatic hydraulically operated control valves in air discharge lines.

some method which will afford optimum engine performance.

It has been determined that for best engine performance, exhaust temperatures of supercharged dual-fuel engines should be maintained within a variation of 50°F from a constant mean, as engine load is reduced. This thermal air control makes use of this characteristic.

To throttle and provide the proper air supply at reduced loads, an air control valve is installed in the air intake line adjacent to the engine intake manifold. This valve is positioned by an air-operated diaphragm motor and positioner which in turn is actuated by an automatic temperature controller. By utilizing engine exhaust temperature to actuate this control, it is possible to get a correct fuel-air ratio to all cylinders at all times and in direct relation to all load changes.

MICROMETERING GAS VALVES—These individual gas metering valves control the gas fuel supplied to each cylinder. They function under direct control of the engine governor and are a necessity if any semblance of balance is to be maintained between cylinders throughout the load range.

They are a balanced type plug, having very accurately milled, tapered flats. The shape of these flats provides a varying orifice which allows for extremely accurate metering needed to maintain correct air gas ratios even at part load. This results in smooth operation at light loads.

Note: Further details for the above features of these engines may be obtained from DIESEL POWER AND DIESEL TRANSPORTATION, *Page 48, March 1952.*

Controls

DUAL-FUEL CONTROL—Control of these engines and sequence of operation can be followed from the graduated quadrant on the right side of the control lever. With the lever in the "Stop" position, all fuel (both gas and oil) is shut off. Movement of this lever slowly through the range marked *Oil* to the position marked *Run*, will start the engine and operate it entirely on fuel oil.

If operation on gas is desired, the control lever is moved upward through the range marked *Gas*. In the extreme top position of the quadrant, the engine is operating on maximum gas. With the lever positioned at any intermediate graduations, the engine will operate with the designated proportions of these fuels as indicated on the quadrant band.

If at any time the available amount of sewage gas to any engine diminishes below the quantity selected, the control lever is moved manually to meet the load demand. Engine speed is under governor control at all times and all changes in fuel proportions are accomplished without dropping engine load or affecting its speed.

SAFETY CONTROLS—Engines are equipped with hydraulic relay-type governors having motor-actuated speed changing devices. Control switches for these are mounted on the main benchboard in the electrical room. From that point, electrical generating units can be synchronized, and the air output of the blower units controlled, by speed variation to meet specific air requirements.

Safety devices are provided to protect each engine against overspeed, low jacket water and lube oil pressure, and excessive water and oil temperature. Should any of these faults occur, an electric horn is sounded and all fuel shut off simultaneously. Visual signal lights for oil circuits and the signal horn are installed in the individual engine alarm boards adjacent to the engines.

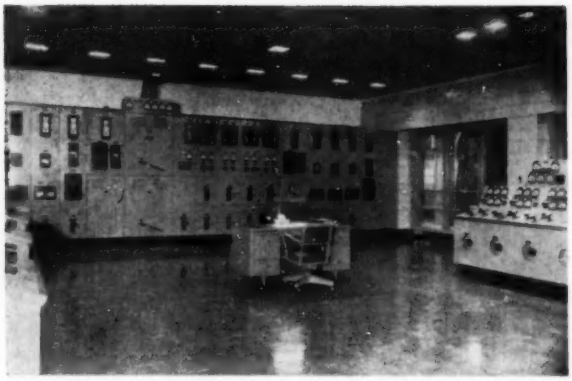
Pyrometers and tachometers are also installed on the engine alarm panels. Individual engine pyrometers indicate temperature for each cylinder, exhaust gas inlet and outlet temperature from the turbocharger, and exhaust gas temperature from the boiler-silencers.

Air Intake System

Each engine takes air from individual viscous impingement type filter panels set in the basement wall. These lines, with a flared inlet connection to the filter frame, run horizontally along the basement ceiling to a vertical riser extending through the main floor to the turbocharger inlet on each engine. A flexible metal pipe connection is installed in the risers.

Exhaust System

Combination exhaust silencers and waste heat boilers, designed for generating low pressure steam, are installed for each engine. These units are designed to operate dry with an exhaust temperature of 800°F, and also generate



Shown above is the Electrical Control Room containing main switchgear. Engine room is to the right of this room.

steam at 5 psi with a feedwater inlet temperature of 160°F. Exhaust gases leaving these boilers are always maintained above 300°F. This prevents condensation, which would occur at the dewpoint, and resultant corrosive action by the sulphur present in the gases.

Exhaust lines are insulated by a 3-in pipe covering, while 4-in insulation covers the boiler-silencer units. Here again, flexible metal pipe connections are installed in the vertical run of the exhaust line leading from the turbochargers.

Fuel Oil System

Fuel oil is delivered by truck and stored in a 10,000-gal underground tank. Duplicate motor driven rotary gear type pumps, each having a capacity of 10 gpm, transfer the oil through a 1-in header to the individual day tanks. In addition, a 10-gpm hand operated transfer pump is installed for emergency use and also to provide for the initial filling of the day tanks. A disc type fuel oil meter and an edge type filter are installed in the header to register and filter the flow to the day tanks. An overflow line from each tank connects to a 2-in return line. Remote reading level indicators, located on the basement wall, record the contents of each day tank and the storage tank.

An attached fuel oil service pump on each engine supplies oil from the day tank to the fuel oil inlet header on the engine, maintaining a pressure of 25 psi to the injection pumps. Since these service pumps supply more oil than required by the engines, the excess is bypassed back to the suction side of the pump. A duplex filter is also installed between the service pump and fuel inlet header.

Fuel Gas System

Sewage gas formed in the sludge digestion tanks is pumped by motor driven compressors, of the rotary sliding vane type, in the control building over to the engine-blower room basement through a 6-in line and delivered at a pressure of approximately 17 psi. After passing through a master meter, it flows through a header to individual gas pressure equalizing tanks or reservoirs set in the open space in the foundation block of each engine. Fittings are provided in the lines to each tank for connecting a portable gas meter to record the gas consumption of any particular engine, if desired.

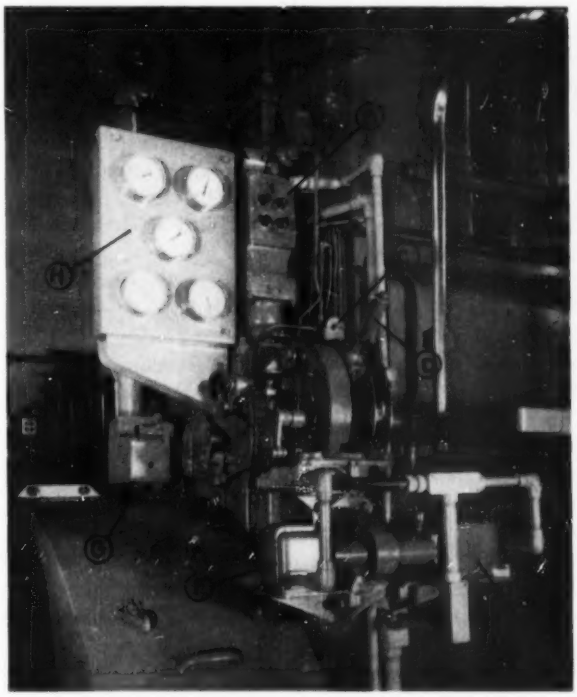
From these tanks, the gas is piped through a diaphragm type pressure regulator to a gas receiver on the engine. The regulator maintains a uniform gas pressure of 15 psi, and the receiver provides an ample supply of gas to the engine at varying loads. This receiver is connected to the fuel gas manifold, mounted along the exhaust side of the engine at its top. Separate branch lines leading from this manifold bring the gas to the individual metering valves mounted on each cylinder head. These valves are operated by control shafts through governor linkage and can be adjusted individually to provide an equal flow of gas to each cylinder. Gas is injected into the cylinder combustion space by fuel gas timing or injection valves operated from the engine camshaft.

To arrest and stop flame propagation in the event of a back-fire, flame trap assemblies are installed in the individual gas supply lines leading from the pressure equalizing tanks to the engine. They consist of a flame trap with arrestor grid, and a thermally-operated shut-off valve having a fusible element set to melt at 200°F. Melting causes the valve to close.

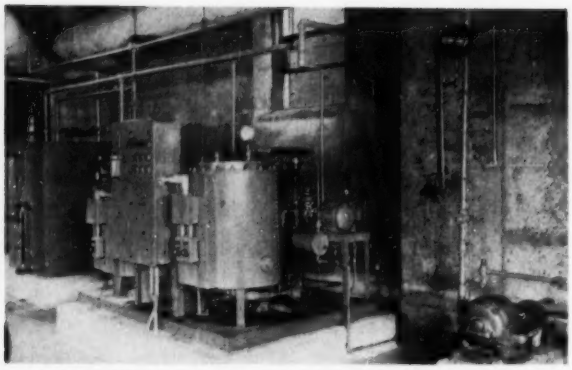
Starting Air System

A conventional starting air system, comprising multiple tanks and compressors, is installed in the engine-blower room basement. Each air tank is equipped with regular trim, consisting of inlet and outlet valves, pressure relief valve, pressure gauge, drain valve, and check valve.

Tanks are filled by duplicate motor driven air cooled



a. Governor synchronizing motor
b. Governor
c. Selector valve (thermal air control)
d. Main control lever
e. Tachometer generator
f. Plugging switch
g. Overspeed trip lever
h. Gaugeboard



In still another section of the basement, lubricating oil storage and treatment equipment is housed.

compressors, each having a capacity of 16.6 cfm free air at 250 psi. The system is equipped with automatic start and stop pressure control to maintain tank pressure between limits of 205 and 250 psi. Scale traps are installed in the lines to each engine, and moisture separators are also provided in each air compressor discharge line to the air tanks and the outlet lines from the tanks to the engines.

While a separate compressed air system is provided for the plant, the engine starting air system is connected to it through a pressure reducing valve, so in an emergency, the engine starting air system can be used to supply compressed air requirements.

Lubricating Oil Systems

Each engine has a self-contained lubricating oil system, consisting essentially of sump, circulating pump, filters and oil cooler. The lower part of the engine base forms the lube oil sump, from which an attached crankshaft driven rotary gear type pump takes its suction. Oil is circulated through twin edge type filters to the shell and tube type lubricating oil cooler, then to the oil manifold in the engine base, and also to various branches from which all internal engine parts are lubricated. This is a pressure type system, oil being supplied at normal working pressure of 40 psi.

To protect the system from excessive pressures when starting up and the oil is cold, a relief valve, set to open at 75 psi, is installed on the discharge side of the oil circulating pump and piped back to the suction side. Also, to insure that the engine receives an ample supply of oil when it is started up and the oil is cold, a bypass relief valve, set to open automatically at a differential pressure of 15 psi, is installed to bypass the oil cooler. It closes automatically once the oil has reached the running temperature, permitting oil to follow its normal path of flow through the cooler.

Each engine has an auxiliary motor driven before and after lubricating oil pump. The controls for this pump are installed in the engine alarm board located adjacent to the engines on the main floor, so that it can be placed in service from that point.

A lubricating oil purifier of the Fuller's earth type, having automatic heat control, is installed on a bypass in the main oil system of each engine. This bypass line is equipped with an orifice to give a continuous circulation of oil through the filter, after which it is returned to the engine oil sump.

Each turbocharger has a completely self-contained lubricating oil system, consisting of rotary gear type circulating pump, filter, finned cooling tube, and reservoir. A normal pressure of about 15 psi is maintained.

Main air blowers likewise have a separate lubricating oil system. Oil is circulated from an oil sump in the blower base by a rotary gear type pump driven from the blower shaft, through a shell and tube type cooler, to sight feed oilers installed at each bearing and the timing gears. From these bearings and gears, the oil is returned to the sump by gravity. A pressure of 15 psi is maintained in the sight feed oilers. All engines and blowers have a central system of oil supply, draining, storage, and treatment.

Individual drain lines from the engines and blowers are connected to a common drain header, where oil can flow by gravity to either the dirty oil tank or the oil reclaimer. All oil tanks have drain lines connected to a waste oil header leading to the waste oil sump, where the waste oil hand pump will deliver the discarded oil to a valved hose connection outside the building.

Vent and overflow lines from all tanks lead to an areaway outside the building. Also, a basket type strainer is installed in the outlet of each storage tank leading to the transfer pumps. All oil tanks are provided with three test cocks for withdrawing small quantities of oil for sampling and analysis. Storage tanks are equipped with liquid level gauges to indicate the contents in gallons, and both the clean and dirty oil tanks have level sight glasses.

Jacket Water System

Heat rejected to the engine jackets and also from the lube oil coolers is used for heating sludge in the digestion tanks, the interchange being through four shell and tube type sludge heat exchangers. The jacket water outlet lines from each engine are connected to a common 8-in discharge header leading to the sludge heat exchangers. Through suitable valving and thermal control a portion of the engine jacket water can be diverted when required, through three sludge water heater converters in the Main Building. Here, additional heat, if needed, is added to the engine jacket water from the low pressure steam heating system of the plant before it is circulated through the sludge heat exchangers.

Since heat requirements for the digester coils vary appreciably, supplemental cooling of the jacket water is necessary at times to maintain a proper inlet temperature to the engines. For this purpose, three jacket water coolers are installed in the blower room basement. They are of identical size, each capable of handling a heat load of 1,800,000 Btu hr and cool 225 gpm of jacket water through a 16°F range, with an inlet temperature of 132°F. Their combined capacity is such that they can handle the entire jacket water cooling requirements of the power plant, a condition which might occur during extremely warm weather in the summer and heat require-

ments in the sludge digestion system are nil. Effluent at 70°F inlet temperature from the treated sewage, is used for cooling the jacket water in these exchangers. Space is provided for future installation of a fourth jacket water cooler.

Circulation of jacket water is by means of four motor driven circulating water pumps installed in the blower room basement. These are of the horizontal, single stage, centrifugal type, having end suction and top discharge. Two of the pumps have a capacity of 125 gpm each, and the other two 175 gpm, when pumping against a 60-ft total dynamic head, thus giving flexibility to the system.

The arrangement of equipment in the jacket water system is seen when tracing the normal path of water flow in the system. The jacket water circulating pumps take their suction from a common header connected to the main return line from the sludge heat exchanger. These pumps circulate the water through the jacket water coolers, which are manifolded to common inlet and outlet headers to the individual water inlet lines to the engines.

The individual engine lube oil coolers are installed in each of these inlet lines, so that all jacket water first passes its respective cooler before entering the jacket water inlet header on the engine. After circulating through the engine jackets, cylinder heads, exhaust manifold and turbocharger jackets, the water flows from the outlet connection on the engines to a common discharge header over to the sludge heaters, thus making a closed circuit or system. To provide for expansion and venting of the system, an expansion tank with vent and overflow to a basement areaway, is installed on a looped bypass between the common discharge header from the engines, and the supply header to the circulating pumps.

The small amount of water required by the blower lube oil coolers is supplied by connecting them with a line from the inlet side of their respective engine lubricating oil cooler. An outlet connection to the common discharge header from the engines completes the circuit.

Since the engines operate under varying load conditions, and likewise, the heat requirements of the sludge digestion system are not constant, some means of water temperature control for the jacket water system is necessary. This is provided at the jacket water coolers. It consists essentially of a Powers No. 10 Regulator mounted on a tee in the jacket water outlet line of the coolers, with its thermostatic bulb directly in the path of flow.

The entire sewage treatment works project was under the jurisdiction of the Department of Public Works of the county of Nassau, headed by John C. Guibert, Commissioner, and Harold Sherman, Deputy Commissioner of Sanitation.

All design, engineering and construction was under the direct supervision of Greeley & Hansen, Consulting Engineers, with Paul E. Langdon, in charge of design and engineering, George M. Hite, supervisor of field operations, and D. K. MacKenzie, Resident Engineer.

Upon completion of the plant its acceptance by the county, A. E. Sparr was placed in charge as Plant Superintendent, with S. J. Murphy as Maintenance Engineer.

Principal Equipment

Engines	Worthington Corporation
Generators and Exciters	Electric Machinery Mfg. Co.
Governors	Woodward Governor Co.
Turbochargers	Elliott Co.
Flexible Couplings	Falk Corp., U. S. Rubber Co.
Blowers	Roots-Connersville Blower Corp.
Intake and Exhaust Silencers	Maxim Silencer Co.
Valves	R-S Products Corp.
Cooling System	
Safety Actuating Devices	Detroit Lubricator Co.
Heat Exchangers	Sims Company
Pumps	Worthington Corporation
Temperature Control Valves	Powers Regulator Co.
Lubricating Oil System	
Safety Actuating Devices	Detroit Lubricator Co.
Coolers	Sims Company
Pumps	Worthington Corporation
Filters and Conditioners	U. S. Hoffman Machinery Corp.
Strainers	Cuno Engineering Corp.
Fuel System	
Shutoff Valves	Automatic Switch Co.
Strainers	Cuno Engineering Corp.
Transfer Pumps	Worthington Corporation
Oil Meters	Worthington Corporation
Gas Meters	Roots-Connersville Blower Corp.
Gas Regulating Valves	Fisher Governor Co.
Gas Compressors	Fuller Co.
Air Intake Filters	American Air Filter Co.
Exhaust Gas Waste Heat Boiler-Silencers	Maxim Silencer Co.
Pyrometers	Illinois Testing Laboratories, Inc.
Tachometers	Weston Electrical Instrument Co.
Alarm and Control Panels	
Switchgear and Benchboards	Federal Electric Products Co. Cole Electric Products Div.
Piping Installation	H. Sand & Co., Inc.

What Do You Know!

More questions to test your knowledge of the diesel field. Mark your selections and turn to page 87 where the correct answers appear.

1. Sewage gas is a good engine fuel, consisting principally of methane and carbon dioxide. It usually requires no treatment prior to use.
   a. True b. False

2. The purpose of throttling intake air at part-load in dual-fuel and gas engines is to:
   a. Maintain even exhaust temperatures
   b. Lower the load on the turbocharger
   c. Improve part-load operation and fuel efficiency

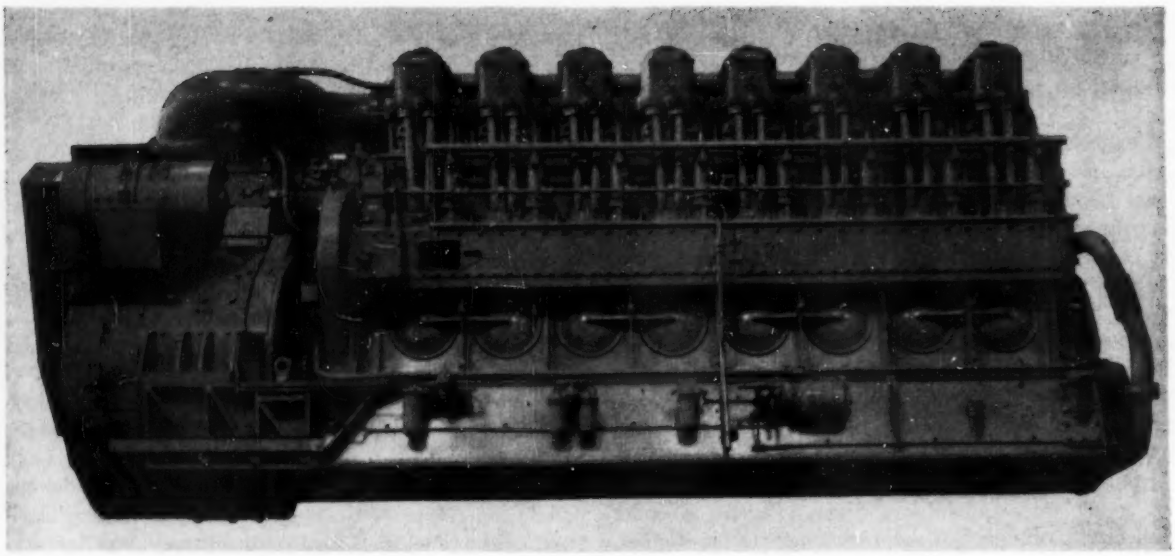
3. Thin-wall, flangeless, precision-type bearings are not suitable for an engine with, say, a 12¾-in bore.
   a. True b. False

4. In a cylinder liner, where is the greatest wear found?
   a. At or near the top end of ring travel
   b. In the center where piston speed is highest
   c. At or near lower end of ring travel

5. If you have a 32-volt battery and need only 12 volts for some reason, you should:
   a. Just tap off at the end of six cells
   b. Get a 12-volt battery
   c. Reduce to 12 volts by a suitable series resistor

6. Detonation and rough combustion are the same thing.
   a. True b. False

7. In spark ignition gas engines, proper air/fuel ratios for maximum economy, maximum overload capacity, or a compromise, as desired, can be set at the mixing valve by reference to:
   a. Exhaust temperature c. Exhaust gas analysis
   b. Manifold vacuum d. Ignition timing



Illustrated above is a turbocharged series 600 Baldwin engine equipped for railroad service.

Increased Power for B-L-H Locomotives

Recent design improvements have boosted the output of the 8-cyl Baldwin-Lima-Hamilton diesels from 1500 to 1600 hp. This, coupled with improvements in the electrical equipment, has increased the continuous tractive effort on some locomotive units as much as 13.5 per cent.

Baldwin 600 Series 4-cycle engines are built with either six or eight vertical in-line cylinders of 12¾-in bore by 15½-in stroke. Maximum full load speed is 625 rpm. Lower rated models are normally aspirated—higher rated models are equipped with turbochargers. Now let's take a look at the improvements.

BEDPLATES are of welded steel construction with heavy cast steel transverse webs provided to support the crankshaft main bearings. All critical welds are magnafluxed to detect possible defects. After rouch machining the entire weldment is stress relieved.

MAIN BEARINGS are precision line bored with one setting of boring bar. Individual fitting of bearing shells in saddles and caps, necessary in early models, is not required with precision bearings. This holds true for the heavy shells first used and the thin shells used with the larger crankshaft. Complete and exact interchangeability (when new) is assured and required running clearances automatically obtained. No shims are used between main bearing caps and bedplate as was the practice in some earlier models. Older models, not having cast steel transverse webs, may be modified by applying fabricated bearing saddle supports. This modification necessitates extensive welding and should be done at Eddystone plant of B-L-H.

Standard 10 in diameter bores for main bearings are common to all 600 series engines. Larger crankshafts with main journals of 9.585 in diam and 8.836 in diam for connecting rod bearings, (previous sizes were 8.750 in and 8.375 in respectively), together with the thin shell bearings used on all current production models may be installed in any 600 series engine. However, a bedplate modification is necessary to accommodate thin shell bearings. This consists of machining a chamfer on each end of bearing bores (to clear a larger fillet of crankshaft) and machining slots in the caps and saddles for locating these bearings. A dowel must be fitted into each main bearing cap to position it on the saddle. This is necessary because of existing clearance between main bearing bolts and bolt holes in caps. Also, thrust bearing caps require dowels for locating bearing cap and thrust flanges.

Main bearings of the copper lead precision type were adopted by Baldwin over three years ago. All engines built since that time have been so equipped. These bearings have a lead-tin overlay approximately 0.001 in thick, which provides a run-in surface.

Here are the differences between heavy and thin precision type bearings:

a. *Heavy shells* (0.6225-in—0.625-in wall) used in engines prior to 1951 model, used a dowel located in a re-

cess in the upper shell and seated in a similar recess in the upper shell and seated in a similar recess in the bearing cap, which serves to locate the bearing. Main bearings at the generator end are flanged and longer than the others. These act as thrust bearings, holding crankshaft an an end play of from 0.014 in (new) to 0.030 in (allowable). With exception of thrust bearing, all main bearings are identical and interchangeable when new.

b. *Thin shells* (0.203-in—0.204-in wall) as applied to the 1951 and later models are steel backed copper-lead bearings with a thin overlay of tin which serves as a run-in surface. They are located by a locking lip fitting into slots in both cap and saddle. All thin main bearing shells are identical, as no special thrust bearing is required. A half circle bronze thrust flange is attached by dowels to each side of the thrust bearing cap.

Annual inspection of main bearings formerly practiced is no longer recommended. Past experience indicates that bearings operating satisfactorily prior to an annual inspection have given trouble shortly after such inspections. This may be due to the fact that a bearing assumes the slight irregularities of the crankshaft journal with which it runs, so that after removal and replacement even in the same location, the chance of the surfaces returning to the identical relative position is very remote.

Consequently, surfaces are mated which have slight irregularities from previous operation. These conditions together with the ever persent opportunities of dirt getting into bearing surfaces and risk of misapplication, indicates a longer period between main bearing inspections. Operating experience has indicated that copper lead bearings may operate 360,000 miles in freight and transfer service; 720,000 miles in passenger service; six years in yard switching service.

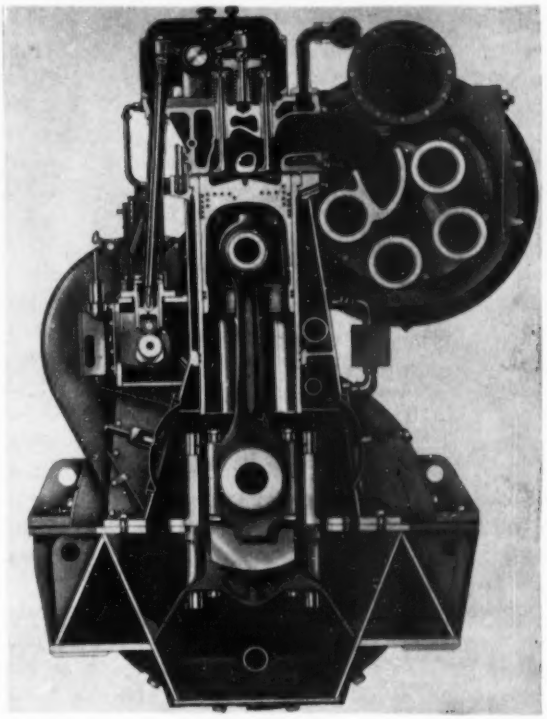
Running clearances should be checked by inserting tapered shim-stock feelers between crankshaft and bearings annually and replacement of bearings shells made after wear limits, as specified in manual, are reached.

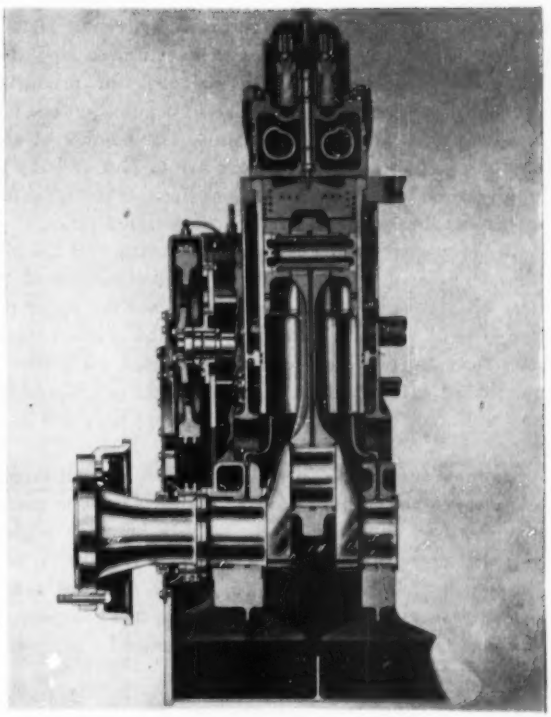
CRANKSHAFTS on recent models are a one-piece heat-treated steel forging. It has larger radius fillets of main journals and crankpins; increased thickness through the webs, and more overlap between the crankpin and main journal to provide greater rigidity. The crankshaft is counterweighted and dynamically balanced for smoother operation. It is drilled for pressure lubrication in such a way that copper tubes required on older shafts are eliminated.

ENGINE FRAMES of the 1951 model engine are of welded steel construction throughout. They are similar in design to the old frames, built up of carbon molybdenum steel plates and have a greater stress carrying capacity than the old frames. The weldment is thoroughly stress relieved and all critical welds are magnafluxed to detect any possible defects in welds.

CYLINDER LINERS are fitted into the upper section of engine frame. Each liner is located by its flange which fits in a machined recess with a solid copper gasket between liner flange and frame to form a water tight seal. When the cylinder head is tightened down the liner is held

Here, the divided exhaust manifold to the turbocharger can be clearly pictured.





This cross-section shows more clearly the lube oil passages to the bearings, piston pin, and crown.

tightly in place. Since the liner will expand considerably more than the frame, due to higher temperatures to which subjected, a free lengthwise expansion is allowed by providing a slip-joint at the lower end. Synthetic rubber rings in the slip-joint serve as a water seal between water jacket and crankcase.

Liners are made of high grade cast iron and inside bores plated with porous-chrome to reduce wear to a minimum. Liner wear usually is greatest during the first few thousand hours after liner has been installed, while on the other hand, wear on piston rings and grooves is greatest when the rings are working in a worn liner. Specifications of liner bores are: taper not more than 0.002 in for length of liner, limit 0.004; out-of-roundness should be limited to 0.004 in.

The recommended maximum diameter limit of worn liner is 12.778 in at point of greatest wear, which as a rule is found at the location corresponding to position of upper ring at TDC or immediately below. It may be possible to operate an engine with liners worn in excess of the limit of 0.028 in oversize if other wear factors such as condition of valves, rings, pistons, which also affect compression pressure are held within satisfactory limits.

If worn liners are used, frequent checks are necessary on compression pressures, which should be 450 psi, at idling speed, and 620—720 psi at full speed, or crankcase vacuum of 0.2 in to 1 in column of water, in order to assure good engine performance.

PISTONS are of heat treated aluminum alloy. Cooling during engine operation is accomplished by a constant flow of oil through steel tubing coils cast in the piston crown.

Pistons having a saucer-type crown were first installed in 600 series engines. Later after extensive laboratory tests, the Hesselman type was adopted for production because it gave greater turbulence in combustion chamber and therefore improved combustion. The number of compression rings was changed from five to four and the top ring lowered into the water area of liner, at the same time increasing the land between top compression rings.

In the newer engines, design characteristics of the modified Hesselman piston included a redesigned wrist pin bore oil groove which does not carry into the upper portion of wrist pin bore. The saucer type and original Hesselman type are provided with a continuous oil groove in one side of wrist pin bore. Piston diameter is 0.010 in less, and additional piston cooling oil turns are provided in the crown.

The new and the old Hesselman pistons are not directly interchangeable because of differences. New type pistons may be used in complete engine sets in older engines, provided new style wrist pins are used. If either type of Hesselman pistons are used to replace a set of saucer-shaped crown pistons, then valve timing, fuel pump timing, and maximum fuel pump rack setting must be adjusted to suit that type piston.

Manufacturing tolerances relative to the combustion chamber are held exceedingly close to insure uniform loading of individual cylinders. This results in a more evenly balanced engine with respect to compression pressures, firing pressures, and temperatures. Consequently, fuel rack settings of accurately calibrated fuel injection pumps can all be set alike and a well balanced performance is assured.

WRIST PINS are of alloy steel and drilled to transmit oil to the piston crown for cooling. Drilling is symmetrical so it can not be assembled improperly. A modified wrist pin having greater cross-section and increased number of holes for feeding piston cooling oil is used with later model Hesselman pistons. This wrist pin is not interchangeable with earlier models except in complete sets. Interchangeability of wrist pins is limited due to the weight of the two pins which would cause an unbalanced condition if mixed in an engine. Weight of original pin is 33 lb—wall thickness 27/32 in, while weight of wrist pin used in 1951 engines is 37.5 lb—wall thickness 31/32 in.

PISTON RINGS: four modified compression rings (instead of five previously used) with increased ring gap (0.080 in—0.100 in) and three oil wiper rings—two below and one above wrist pin hole are now used. Either the new or the old compression ring may be used with the new Hesselman piston when installed in the newer engines, provided the ring gap clearance is increased (0.080 in—0.100 in).

CONNECTING RODS are of two piece design made from an alloy steel drop forging of "H" cross-section. Each rod is magnafluxed for detection of forging cracks or other defects.

Wrist pin and crankpin bores are finish ground to exact size and parallelism of bores is held very close. The connecting rod is rifle drilled for lubrication of wrist pin bearings.

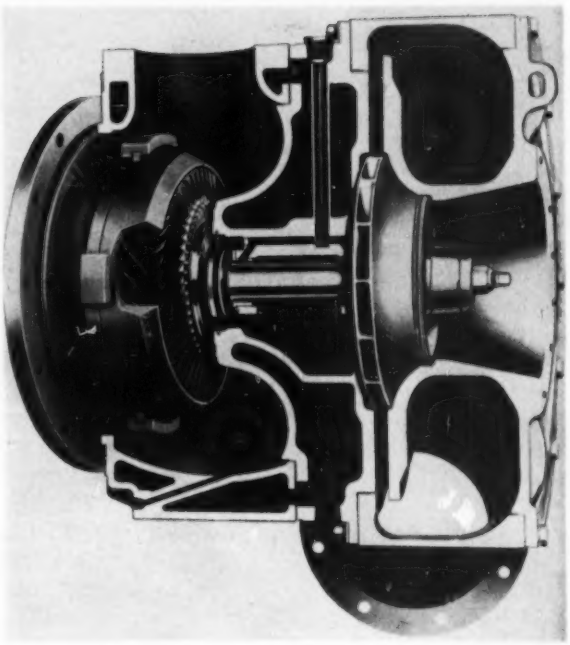
Connecting rods for 1951 models are heavier in section than in previous models because of increased power requirement. The rotating ends are held to a weight tolerence of 1 lb for improved engine balance. This connecting rod cannot be used as a replacement for rods used in older engines. In the event that a large crankshaft is applied to an older engine the old connecting rods can be reworked to accommodate thin shell bearings. A chamfer is provided on each end of bore and bearings slots must be machined in rod and in cap.

CRANKPIN BEARINGS are of the precision type and fit into connecting rod without necessity of scraping seat in rod, adjustment of shims, or selective fitting of any kind. Bearings are provided with the necessary crush to assure proper seating in rod bore when bolts are tightened to required torque setting.

While engine models prior to 1951 were turned out with crankpin bearings having flanges which take side-wise thrust of connecting rod-piston assembly, a flangeless copper lead bearing has been developed as a replacement for all flange type bearings previously furnished. This bearing was developed so that customers could obtain a premium bearing at lower cost.

Frequency of inspection of copper-lead bearings on crankpins should be in line with recommendations made for the same kind of main bearings.

At the right, a cutaway view of the turbocharger used on these engines. Water jackets surround the turbine casing at left, as high temperatures are encountered here during operation. Vertical pipe in the center casing is the oil inlet line to bearings.



CYLINDER HEADS are individual castings of heat-treated cast iron. Each head is attached to frame by six alloy steel studs which, when tightened to required torque setting, provide even seating of head. It is important to obtain equal compression in all cylinders, as a difference in gasket thickness of 1/32 in corresponds to an increase or decrease in compression of approximately 27 psi.

Water passages are built into head to provide proper circulation of cooling water to keep operating temperatures at a safe level, as a guarantee of proper valve functioning as well as to prevent distortions and thermal cracks.

After long range experience and test, it was found that the side water jumpers from point about the center line vertically of the engine to the head could be eliminated without jeopardizing efficient cooling of head. These jumpers may be removed from older engines by plugging connection openings in head and frame. This will eliminate some maintenance troubles, because of leaks at connections.

Cylinder heads as used on late model engines may be applied to earlier models by removing side water jumpers (if so equipped) and plugging holes in the jackets. Heads for older engines may be applied to later engines by plugging side water jumper hole in head. Cylinder heads which are not provided with the bolted down valve bridge stem guide must be machined to suit the flange mounting of stem guide, if this design is used.

VALVES are of identical design for both intake and exhaust. SAE 3140 alloy steel is used for intake valves and most of the stems of exhaust valves, while a special heat resisting steel is used for exhaut valve head and a portion of stem.

Identification of exhaust valves may be made by weld line on stems, also be "EX" stamped on bottom of heads, while intake valves are marked by "IN" in the same manner.

Valves are held to seats by double helical springs (original design used only one spring) mounted around upper end of valve stem. Latest design uses split keepers, an improvement over an earlier arrangement which used a locking nut.

Valve timing is properly set when engine is tested at factory. However, it should be checked periodically, as should inlet and exhaust valve tappet clearances.

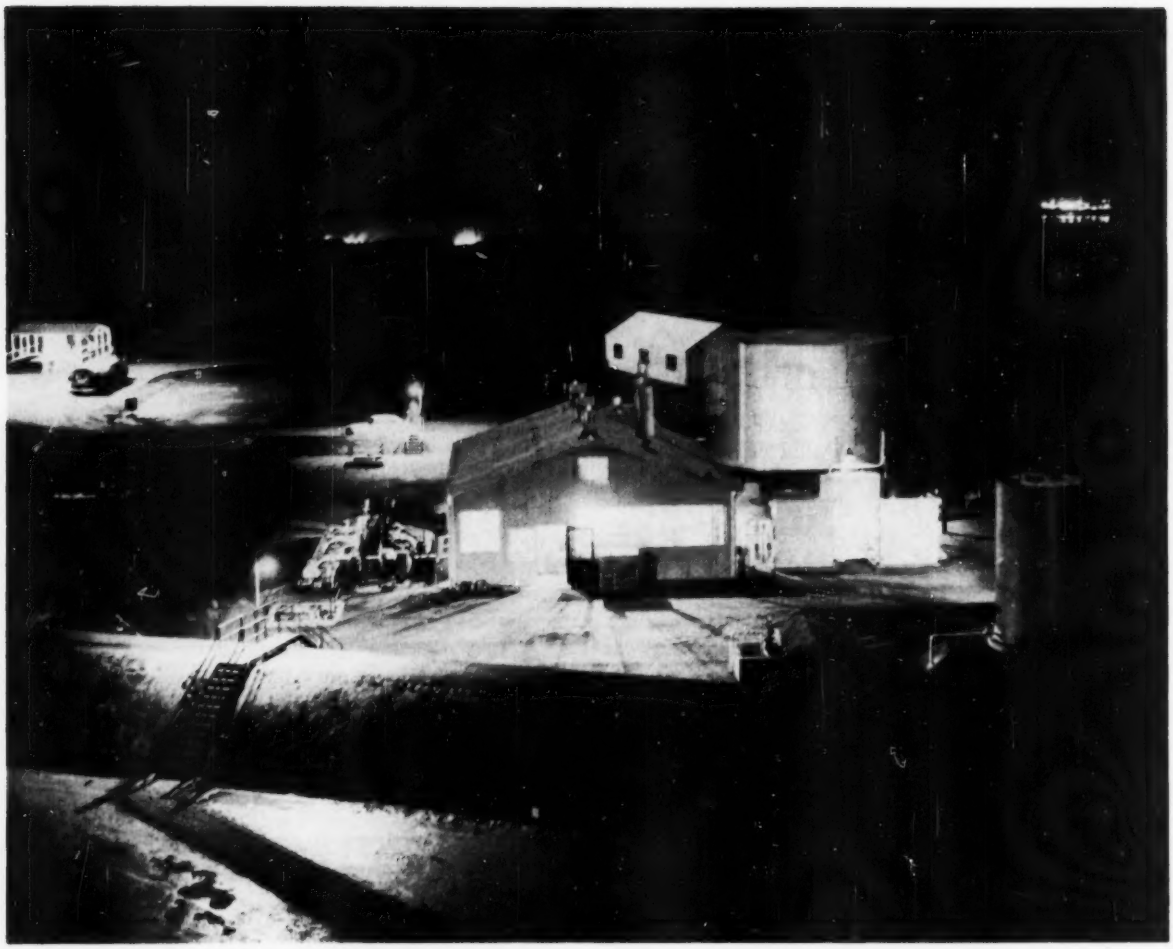
A new design of inlet and exhaust cam roller and pin, incorporating a floating bushing and pressure lubrication has been developed and is now furnished on all production engines. These roller, pins and busings may be used to replace the needle bearing type rollers and pins formerly used. However, the existing cam follower brackets must be drilled for application of pressure lubrication. Copper tubes are used to transmit oil from fuel pump roller pin supply in cam follower bracket to push rod rollers and tappet guides. All push rods are interchangeable.

CAMSHAFTS are mounted in split type removable precision bearing shells and are driven from the crankshaft by a roller type chain on generator end of engine. In addition to operating valve gear and fuel injection pumps, the camshaft also drives the engine governor and mechanical over-speed stop through bevel and pinion gears. Camshafts are rifle drilled and supplied with pressure lubrication which furnishes oil to its bearings as well as to fuel pump, intake and exhaust rollers, and pins.

Since cams are integral with camshaft and ground in their relative timing positions with respect to one another, it is only necessary to adjust valve timing at one cylinder, when setting crankshaft and camshaft in their proper angular relationship.

WATER PUMPS of a new design are employed in late model engines. As a result, it is directly interchangeable with all other pumps in service. The new pump has a larger shaft, larger bearings, and a mechanical carbon type seal and impeller overhang was reduced. The design was changed so that it is no longer necessary to thread the chain around the sprocket, since the sprocket is mounted on the end of the pump shaft and is overhung.

Present model engines are equipped with a new design of turbocharger which assures full engine power up to 8000 ft altitude. It is lubricated from the engine lube oil pressure system and is cooled by circulating cooling water through the turbine casing and back plates.



Looking from the top of a 135,000 bbl oil storage tank we see the pumping station and a tanker loading off shore.

Diesels Power Tanker Loading Station

By Milo D. Pugh

A crude oil tanker loading station completed late last year by the Union Oil Company at Venture, California, is said to have the largest capacity of any tanker loading plant on the West Coast. The maximum capacity at full load is approximately 12,000 bbl an hour through a 20-in cement coated pipe line. The line, 4280 ft in length, is partly on land and partly submerged in the ocean. The cement coating not only protects the line, but the added weight helps to keep it submerged.

A 10-in rubber hose, 140-ft long, connects the ship side of the 20-in steel and concrete line to the ship. This flexible hose compensates for the rise and fall of the tanker in rough seas. In addition to the crude oil line, there is an 8-in line which is used to take off gasoline and other refined petroleum products. These products are pumped from the tanker to marketing storage tanks where they are delivered by highway tank trucks to the consuming areas of the Ventura, Santa Barbara vicinity.

Tankers operate between Union Oil refineries located near San Francisco and Wilmington, California, bringing gasoline or fuel oil from the refineries and returning with a load of crude oil which comes from the wells in the Santa Paula area. As the crude is pumped from the wells, it is stored in a tank, 42-ft high by 145 ft in diam. This

huge tank, built by the Chicago Bridge & Iron Works, has a capacity of 135,000 bbl. The layout of the pumping station provides for the later addition of a similar size crude oil storage tank.

The pumping plant with its manifold system is arranged for three services:

1. To pump the crude oil from the Santa Paula field to the station storage tank.
2. To pump the crude oil from the storage tank to the tanker at sea.
3. To pump back to storage the 2400-bbl crude oil remaining in the pipe line following each tanker loading, replacing this with water.

Power for this pumping operation is supplied by two model DSG-6 Enterprise diesel engines rated 465 hp. Each of these engines drives a centrifugal pump through a speed increaser with a ratio of 3.5 to 1. Normal engine speed is 450 rpm, with a pump speed of 1575 rpm. In addition, the engines are provided with an auxiliary lube oil pump. The function of the pump is to circulate lube oil through the engines during the starting-up period, thus assuring proper lubrication until the engines are up to speed. The auxiliary pump may also be run after the engine is shut down to aid in cooling.

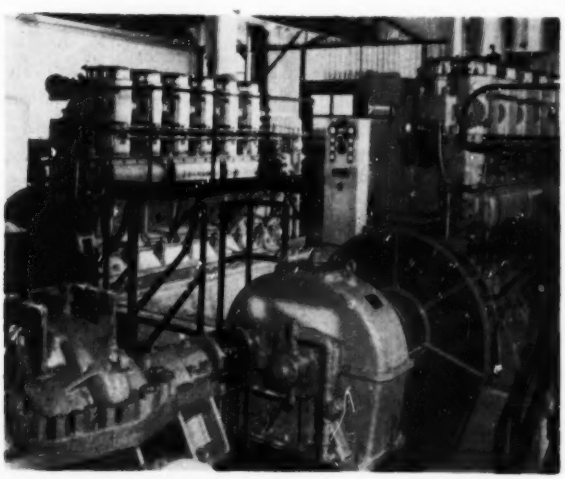
Each diesel is provided with a gauge board of special design. Since the engines operate only intermittently, it is essential that when operating, all controls be readily accessible from, and within view of, a central point. Time is extremely critical, due to the fact that refined products are unloaded from the tanker at the same time that crude is being loaded in the tanker from the land based storage tank.

Once operation is started, it is important that every man be at his post and that everything is operating properly. These gauge boards contain gauges for reading suction and discharge pressures; a tachometer; an exhaust pyrometer; pressure gauges for jacket water, starting air, lube oil, and fuel oil; and thermometers for lube oil and jacket water temperatures.

Above, one of the control cubicles showing gauges, tachometer and multi-point exhaust pyrometer which attendant is reading.

At the right are the fire station, pumping station and crude storage tank. In the left foreground a tank truck is taking on refined products.

Below are the two Enterprise engines which are the principal prime movers for pumping station.

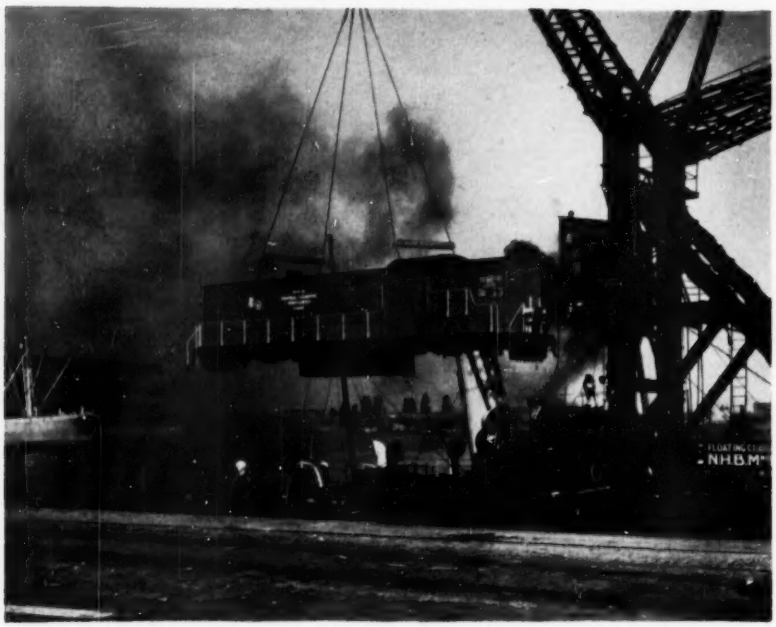


Jacket water and lube oil cooling is provided by radiators located outside of the engine room. Jacket water make up is treated before use in the cooling system.

The power plant building, as well as the fire house, are steel frame covered with corrugated transite board. The transite not only resists fire but it is unaffected by salt corrosion.

Station fire protection facilities include a 2000-bbl water storage tank and a fire pump building. The crude oil pumping building is further protected by an automatic sprinkler system. A system of dikes surrounds the entire grounds. Oil stabilized fire walls will trap the oil, should a break or leak occur, as well as keep out possible flood water in case of heavy rains during the winter rainy season.

DIESEL BRIEFS



Canadian Built Locomotives for Brazil

Here is the first of 48 diesel-electric locomotives being built by the Montreal Locomotive Works, Ltd., for the Central Railway of Brazil.

Designed for Brazilian operation, instruments are calibrated in the metric system and lettered in Portuguese. Incorporated in the locomotives are such advanced features as dynamic braking, automatic power cutoff, and special sanding equipment for all eight traction wheels.

These locomotives were designed to operate on the broader gauge tracks used in Brazil (5 ft 3 in) which are 6½ in wider than the North American standard.

Power is supplied by an Alco vee-type 12-cyl 1600-hp 9-in by 10-in diesel equipped with an Alco Turbo-super charger. The unit is capable of developing 52,500 lb of continuous tractive effort. Engine speed at full load is 1000 rpm. Traction motor gearing is 65:18 with continuous maximum speed of 65 mph.

Diesels Oust Steam Locomotives On Canadian Algoma Central

The Algoma Central Railway has become Canada's first to use diesel locomotives exclusively. Traffic Manager J. P. Mader, termed it the "end of an era".

Twenty-one diesel road switchers are now doing the work of 39 steam locomotives, better and cheaper, he said.

The lines total trackage is 327 miles. Founded in 1899, the railroad did a gross business last year of more than $10 million, moving pulpwood, iron ore, steel, coal, and sulphur.

Railroad-Trucking Executive Urges Better Highways

Abraham Watner, head of both a railway and trucking firm, warned recently that restrictions on any one form of transportation hurt all carriers.

In an address before the Milwaukee Transportation Club, he asserted that "transportation in the U.S.A. is indivisible." In his dual role, he said "I found that you can't cut up American transportation into little pieces . . . without hurting the whole system."

He attacked restrictions on transportation, citing unreasonable ICC regulations hampering railroads and unreasonable state limits on weight and length that hamper trucks, calling for "complete cooperation and harmony" among all kinds of carriers.

New Hallet Diesel Distributor

The Griffin Equipment Corp., 330 E. 141 St., New York City, has been appointed exclusive territorial distributor for the Hallet line of low hp diesels. The territory takes in southern Connecticut, southern New York, and the northern half of New Jersey.

Fourth Annual Diesel Power Plant Operators Conference

The Fourth Annual Diesel Power Plant Operators Conference will be held at Oklahoma A & M College, November 17-19, 1952.

Subjects to be discussed include: industrial paints; preventive maintenance; vapor phase cooling; corrosion problems; pyrometers; cylinder pressure indicators; governors; lubrication. **All who are interested** are invited to attend.

National Supply Co. to Market Lister Diesels in U.S.A.

The National Supply Co. has announced that it is now sole distributor within the continental United States for Lister diesel engines, manufactured by R. A. Lister & Co., Ltd., England, in addition to its own engines.

Emphasis will be placed on the sale of a new line of Lister engines first announced in May 1952, the "Freedom Range". This line is made in 1, 2, 3, 4, and 6 cylinders, in a range from 8 to 54 hp. The engines will be equipped with American accessories to minimize service and replacement part problems.

DIESEL BRIEFS

RR Shift to Diesels Called Fastest in Transport History

Installation of diesel locomotives has brought about the most rapid change-over in a type of motive power in the history of transportation, William T. Faricy, president of the Association of American Railroads, stated recently.

Addressing the National Association of Shippers Advisory Boards, Mr. Faricy said that diesels were used for about 65 per cent of all freight service, more than 70 per cent of passenger service, and more than 75 per cent of yard and switching service in the first seven months of this year.

He said that in the last year, the ownership of diesels has gone up from fewer than 17,000 units to almost 20,000 units and predicted that there would be more than 21,000 units in service next year. He termed the gain in ownership of 22,500 new freight cars during the last year "disappointingly low", but said it was "progress in the right direction".

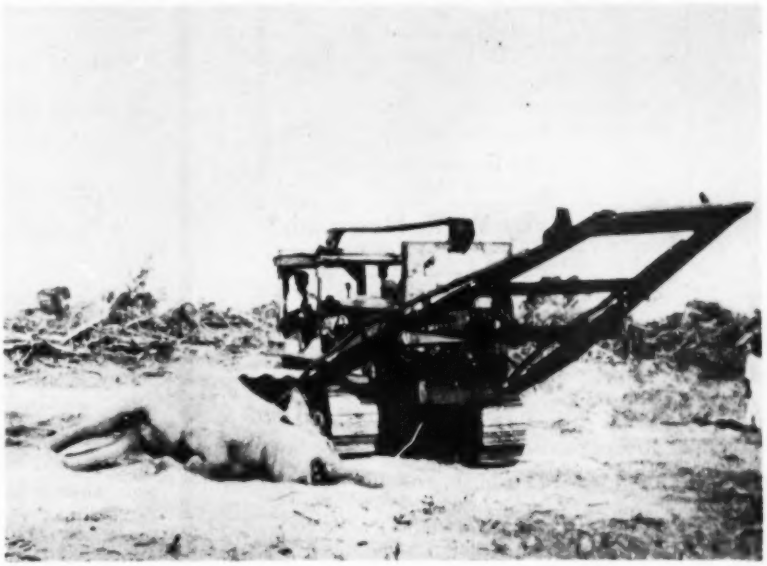
New Rock Island Diesel Repair Shop

A new shop for the maintenance and repair of diesel engines has just been opened by the Rock Island Lines at Silvis, near Rock Island, Illinois. The shop will service principally freight diesel engines.

There are four servicing tracks. Under the new arrangement, engines entering the shops are first fueled, then washed by an automatic assembly-line method.

British Industries Fair Expects Record American Attendance

A record number of American buyers are expected to attend the 1953 British Industries Fair, to be run from April 27 to May 8, it was recently announced. Exhibits by 2500 British manufacturers are to be displayed at the fair, which is operated exclusively for buyers.



Caterpillar Lowers Boom on Elephant

Today, we hear of diesels taking over from steam and gasoline power in a great many applications. However, in a recent release from the Caterpillar Tractor Company, we learn that diesel powered equipment is also taking over from elephants.

The incident took place in the Ceylon jungles where four D-8 tractors were pulling a long loop of chain in tree-felling operations. At one point, the chain encircled a herd of wild elephants which weren't too happy at the sight of the tree dozers.

A young bull, determined to protect his herd, charged one of the tree dozers. The dozer operator, deciding to meet the challenge, leveled the boom, shifted into second gear, and charged the angry elephant. When the dust cleared, there was one dead elephant and one slightly damaged D-8.

First Canadian-Built Diesels Sold to Brazil

Announcement has been made by the Montreal Locomotive Works Ltd., of shipment of six, 123-ton diesel-electric locomotives, first of an order for 48 under construction by the company, for the Central Railway of Brazil. According to the president of the Canadian firm, this is the first shipment of Canadian-built dieisels to South America.

Hill Diesel Changes Hands

A controlling interest in Hill Diesel Engine Corp., of Lansing, Michigan, was bought recently by Melvin T. Berry, president of Barton Corp.

Mr. Berry acted as head of a syndicate in making the purchase from Drake America Corp. At a special stockholder's meeting after the transaction, he was elected president and treasurer, and Theodore Jaffe and Jacob Goodman, Rhode Island lawyers, were named directors of the corporation.

Credit line for the article, "Calibrating Fuel Injection Systems", which appeared in our October issue, was unfortunately omitted. C. S. McKinley, vice president of Automotive Products, Inc., Portland, Oregon, is the author.

A Look at Combustion in Gas Engines

by W. K. Newcomb*

Fundamentals of combustion in heavy duty gas engines, the factors affecting combustion and the effects of variables are explained. After this background, methods of adjustment to get optimum opreation are outlined.

ENGINEERING progress in the past decade has set new horizons of efficiency and output for spark ignition engines. Advances in metallurgy and design have contributed generously to these improvements but the greatest gains have resulted from increasing compression ratios and supercharging.

Recently, the use of large spark ignition gas engines has been greatly expanded by the rapid growth of the natural gas and petroleum industry. This article reviews combustion fundamentals and shows why this progress was possible and how it was made.

The Otto Cycle

Dr. Otto was one of the first to recognize the advantages of compressing the air-fuel mixture and in 1876 built a practical 4-cycle gas engine. In 1882, Sir Dugald Clerk showed mathematically how raising the compression ratio would improve the efficiency.

The Otto or "constant volume" cycle can be better understood by reference to Fig. 1. The theoretical cycle calls for isentropic compression (AB), adding heat at constant volume (BC), isentropic expansion (CD), and blow-down (DA). Also shown, are typical indicator cards for 2 and 4-cycle engines. The efficiency of the theoretical cycle varies with the compression pressure and can be calculated as shown in Fig. 2.

Using the simple "air cycle" efficiency equation suggested by Clerk, we obtain Curve A. However, this efficiency is unobtainable and is never realized because the actual working fluid does not follow the perfect gas laws. Later investigators developed the more realistic "fuel-air cycle" which takes into consideration actual fuel composition, change in specific heat of the working fluid with temperature, change in number of molecules before and after combustion, chemical equilibrium, and other factors.

Hence the fuel-air cycle provides a more accurate yardstick for gauging engine performance. Curve B shows the fuel-air cycle efficiencies obtained when these factors are taken into account. Curve C shows brake thermal efficiencies reported in actual engines. The brake thermal efficiency, including heat and friction losses, approaches the fuel-air cycle to within 20-25 per cent and represents the thermal efficiency obtainable in an actual engine.

Gain due to raising the compression ratio is two-fold; specific fuel consumption is decreased and maximum engine output is increased. Both factors contribute to a lower heat rejection rate and put more of the fuel heat value into useful work. Fig. 3 shows typical specific fuel consumptions at different compression ratios.

However, another factor is often overlooked. When compression pressure is increased, maximum firing pressure is also increased. High firing pressures go hand-in-hand with high thermal efficiency. One cannot be obtained without the other. Fig. 4 shows this effect. This calls for strengthening of engine parts and improving of bearings. Any attempt to limit the maximum firing pressure will decrease efficiency (Fig. 5).

We must not be mislead into thinking that we can keep increasing the compression ratio indefinitely because the gain in efficiency diminishes as the compression ratio is increased. In an actual engine, indicated thermal efficiency levels off at a compression ratio of about 15, and special fuels are required. Brake thermal efficiency reaches its maximum value earlier, at around 12.

However, usually before the point is reached, another obstacle limits the output and efficiency of spark-ignition engines and blocks the use of higher compression ratios.

* *Ingersoll-Rand Co., Painted Post, New York.* *Abstract of a paper entitled "Combustion Fundamentals of Heavy Duty Gas Engines", presented by the author at the 24th Annual Conference, Oil and Gas Power Division, ASME, in Buffalo, N. Y.*

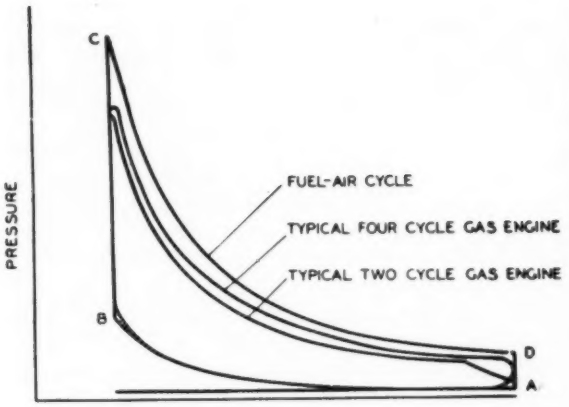


FIG 1 THEORETICAL AND ACTUAL GAS ENGINE INDICATOR CARDS

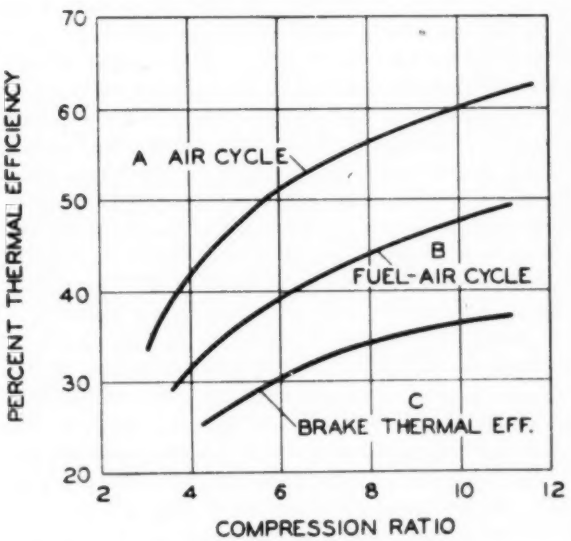


FIG.2 THERMAL EFFICIENCY VS COMPRESSION RATIO

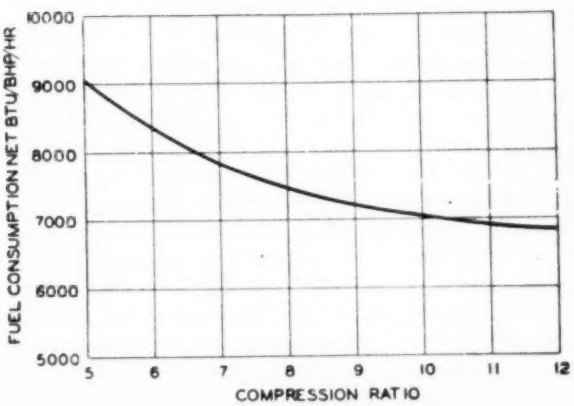


FIG.3 FUEL CONSUMPTION VS COMPRESSION RATIO

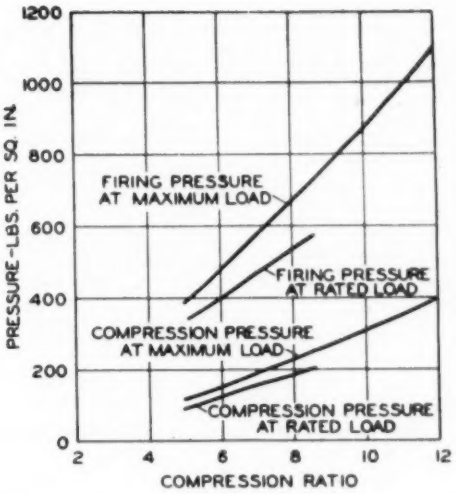


FIG. 4 FIRING AND COMPRESSION PRESSURES VS COMPRESSION RATIO

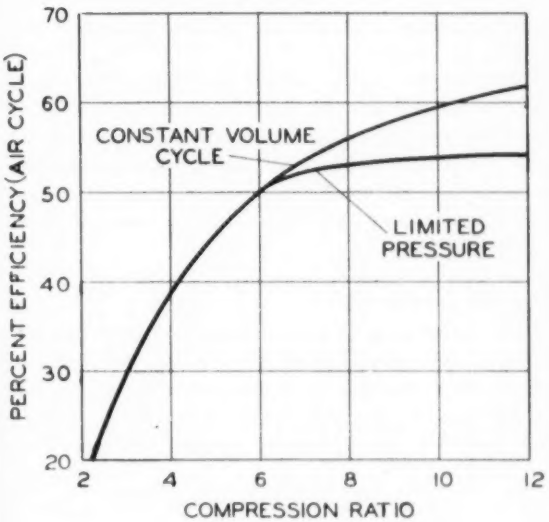


FIG. 5 EFFECT OF LIMITING FIRING PRESSURE ON EFFICIENCY

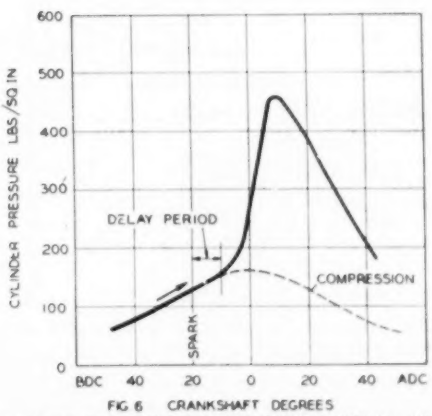


FIG 6 PRESSURE-TIME INDICATOR CARD SHOWING NORMAL COMBUSTION

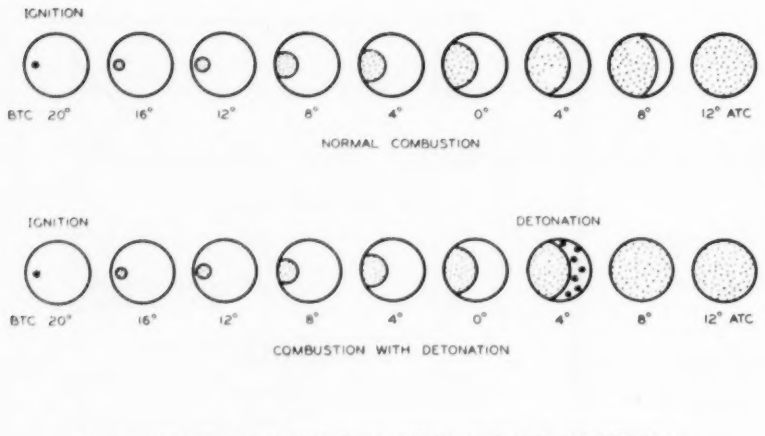


FIG. 7 ADVANCE OF FLAME FRONT WITH NORMAL COMBUSTION AND DETONATION

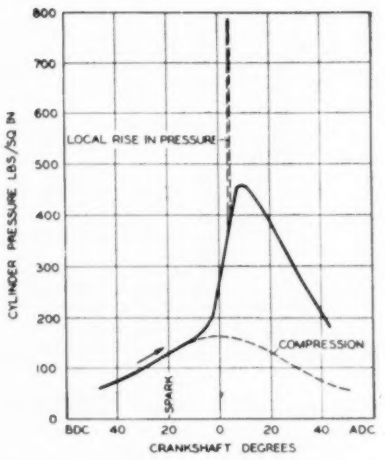


FIG. 8 PRESSURE-TIME INDICATOR CARD SHOWING DETONATION

It is the phenomenon of detonation. It is better known to owners and operators of automobiles rather than heavy-duty gas engines. It is common in the automobile engine if a low-octane gasoline is used or the spark is advanced too far and is accompanied by a characteristic sound known as "pinging".

With larger engines where operating conditions and engine adjustments are better controlled, detonation is rare, but when it occurs, it produces a sharp knock. However, the possibility of having detonation exists and places a practical limit on the compression ratio. In order to better understand detonation, let us compare it with normal combustion.

Normal Combustion

The compressed fuel-air charge is ignited almost instantly by the electric spark but burning gets under way slowly. For example, in a heavy-duty engine operating at 330 rpm, the spark is timed 20 deg before TDC, but the crankshaft advances 9 or 10 deg (.005 sec) before pressure in the combustion chamber rises appreciably (See Fig. 6). After this delay, combustion is well established and the flame front spreads with increasing velocity and the heat released causes the pressure to rise.

When the piston reaches TDC, the flame front has advanced sufficiently to burn about one-half the fuel-air charge and the pressure is rising at its fastest rate. Combustion continues at this pace until rising temperature and pressure produce sa condition of chemical equilibrium. As combustion progresses, the carbon part of the hydrocarbon fuel does not completely burn to CO_2 but increasing quantities of CO form as the temperature rises.

Similarly, the hydrogen part of the fuel does not completely burn to H_2O but free H_2 and HO remain. During the process in the combustion chamber there will be found CO_2, CO, H_2, O_2, H_2O, HO, a little nitrous oxide and unburned hydrocarbons. Then, as chemical equilibrium is reached, the reaction slows down and at about 10 deg after TDC, the maximum firing pressure is reached.

As the piston recedes, further chemical changes take

TABLE I

CRITICAL COMPRESSION RATIO OF HYDROCARBONS

HYDROCARBONS	CRITICAL COMPRESSION RATIO
Methane	12.6
Ethane	12.4
Propane	12.2
Ethylene	8.5
Iso-Butane	9.0
Iso-Octane (100 Octane Number)	7.3
Normal Butane	5.5
Pentanes	3.91—1.65

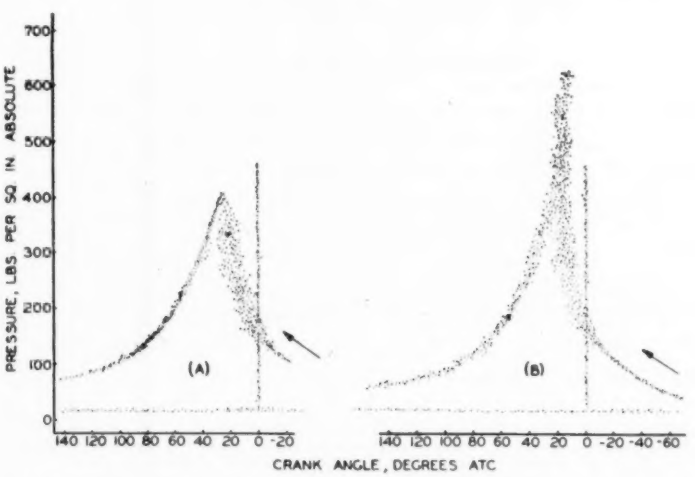


FIG. 9 INDICATOR CARDS TAKEN WITH MIT INDICATOR (SLOAN AUTOMOTIVE LABORATORY)
(A) NORMAL COMBUSTION
(B) DETONATION INDUCED BY ETHYL NITRITE

place during expansion and continue after the exhaust is released. This accounts for the blue-white flame seen at night from short exhaust pipes, for example, in airplane engines.

Detonation

Now let us look at an engine that is detonating. The first phase of combustion, kindling of the fire, is exactly the same as in normal combustion. The second phase starts the same as normal combustion, but as the flame front advances, the rising pressure compresses the fuel-air charge ahead of the flame front and its temperature rises. During this period chemical changes take place (some exothermal, others endothermal) making the mixture unstable.

Finally, auto-ignition occurs (See Fig. 7) at one or more points ahead of the flame front and this highly compressed mixture bursts into flame with a violet explosion setting the gas in the combustion chamber in resonant vibration, producing the characteristic detonation knock.

A sensitive pressure indicator connected to the combustion chamber where detonation is taking place, will show local pressure going very high, perhaps several times that of normal combustion. This effect is only transient (See Fig. 8). A pressure indicator placed at the other end of the combustion chamber will show a lower pressure. Detonation pressure waves quickly subside and pressure in the cylinder becomes equalized. Expansion then takes place as with normal combustion. Fig. 9 shows actual indicator cards of normal combustion and detonation.

Detonation is objectionable in all engines because of the shock effect. If severe, it will cause loss of power and damage to engine parts. It can be stopped by lowering the compression. Also, combustion chamber shape, spark plug location, and turbulence are important factors in raising the detonation level. In one engine, four different spark plug locations were tried before the optimum was found.

There are other factors affecting detonation but it is not always feasible or practical to take advantage of them. For example, high load causes detonation and reducing the load stops it. It is important to avoid rating an engine too high. High ambient temperature has been known to cause detonation. Lowering the air temperature will stop it, but an engine must be able to run on any air temperature encountered. Likewise, high water cooling temperature promotes detonation, but high water temperature is desirable to minimize cylinder wear. Retarding spark timing reduces tendency to detonate but this reduces power and economy.

The heavy-duty gas engine owes its existence to its ability to operate on relatively low cost natural gas or waste gases which are by-products of the petroleum or chemical industries, and it must operate on whatever gas is available. We cannot tailor-make the fuel to suit the heavy duty gas engine as was done for the automobile and aviation engines.

Fortunately, natural gas and many industrial gases make excellent fuels for spark ignition engines and have anti-knock ratings exceeding the best aviation gasolines. Table I shows the critical compression ratios of some common gases. Many of them have higher critical compression ratios than 100 Octane gasoline. The Octane method of rating fuels, while satisfactory for motor fuels, is inadequate for gas engine fuels and another scale such as "critical compression ratio" must be used.

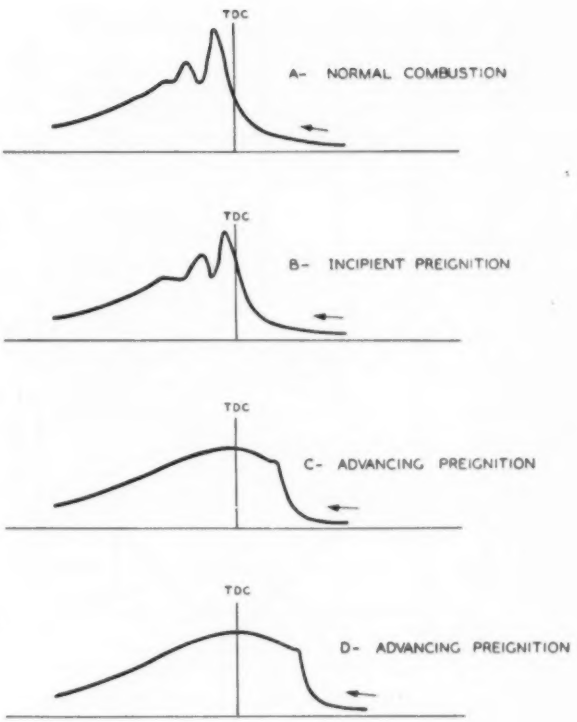


FIG 10 NORMAL COMBUSTION AND PREIGNITION

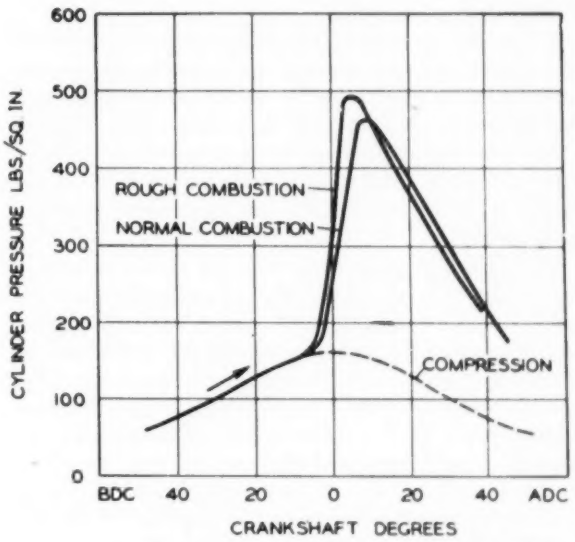


FIG 11 NORMAL AND ROUGH COMBUSTION

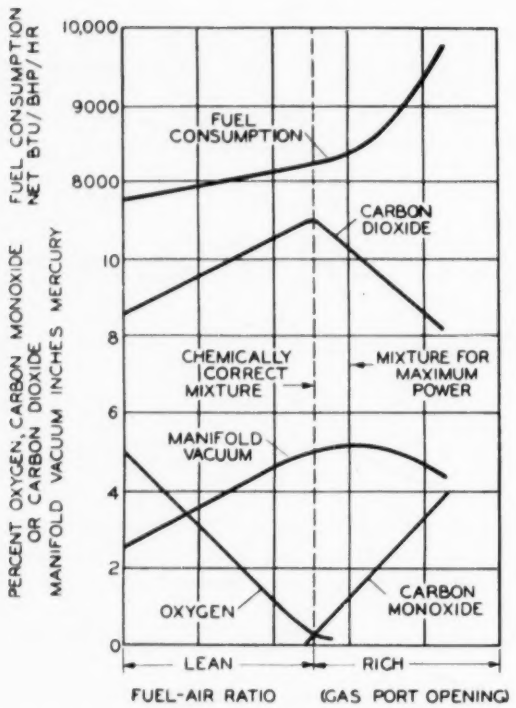


FIG 12 EFFECT OF MIXTURE ON EXHAUST ANALYSIS AND FUEL CONSUMPTION

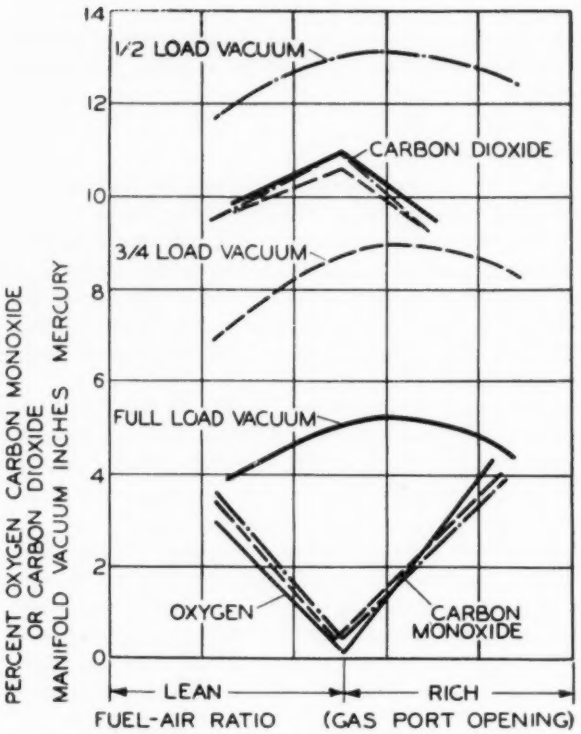


FIG.13 VARIATION IN MANIFOLD VACUUM AND EXHAUST ANALYSIS WITH DIFFERENT MIXTURES

Preignition

Detonation is often mistaken for preignition, but there is no direct relationship; they are two different phenomena. Preignition is combustion occurring before the electric spark through ignition of the fuel-air charge by a hot surface such as spark plug electrode, valve, piston top or carbon deposit. Detonation is accompanied by a characteristic knock, but preignition may be as silent as normal combustion.

Preignition is often progressive as in the case illustrated (See Fig. 10). The incipient preignition increases negative work and heat losses making preignition occur earlier in following cycles by raising the temperature of the hot spot, etc. In the meantime, the governor opens the throttle wider and wider to take care of the increased negative area of the indicator card. Finally, when the throttle is wide open and the overload capacity of the engine is used up, it stalls. In a large engine, the process from incipient preignition to stalling may take 10 minutes.

Preignition is not common in modern heavy-duty engines with well-jacketed combustion chambers and cold spark plugs. Raising the compression ratio does not seem to increase it. However, preignition, like detonation, is affected by the fuel.

Fuels like methane, ethane, propane, etc. are highly resistant to preignition, but unsaturated hydrocarbons such as found in some manufactured gases preignite more readily. Laboratory tests show that lean mixtures are more readily ignited by hot surfaces than rich mixtures and this condition is also found in engines. When incipient preignition occurs in an engine it can usually be stopped by adjusting for a richer mixture.

Rough Combustion

Rough combustion is sometimes mistaken for detonation although they are not the same. Rough combustion is a very rapid rise in pressure. This is quite different from detonation which is auto-ignition of the unburned charge ahead of the flame front. Fig. 11 shows pressure-time indicator cards of normal (smooth) combustion and rough (noisy) combustion. Smooth combustion can be achieved by combustion chamber design.

Rough combustion is not as severe as detonation but it is objectionable because of noise and increased impact loading.

Mixing Valve Adjustment

Up to now we have discussed combustion largely from the standpoint of the engine designer and test engineer. However, many of the things learned in the laboratory and on the test block can be applied by the operating engineer to keep his engine running at maximum efficiency.

Four-cycle naturally-aspirated engines will operate smoothly over a wide range of fuel-air mixtures, as for example, 25 per cent lean to well over the rich side. As the mixing valve is readily adjusted in these engines, it is an easy matter to obtain the optimum fuel-air ratio.

Fig. 12 shows what happens when the mixture adjustment is changed. Load is held constant and the exhaust analysis and fuel consumption obtained for different fuel-air ratios are plotted against mixing valve gas port opening. The lowest fuel consumption is obtained with the leanest mixture that will give uniform firing without missing.

By connecting a vacuum gauge or mercury manometer to the inlet manifold, we find that the manifold vacuum increases as the mixture is adjusted from "rich" to "lean", and then it decreases again. The manifold vacuum peaks at a slightly rich mixture. This is true for all loads from "no-load" to "overolad" (See Fig. 13). The importance of this observation is that it shows we do not have to use the Orsat apparatus or an expensive exhaust gas analyzer to adjust the mixing valve. A simple vacuum gauge or manometer will do.

The first step in adjusting the mixture is to "peak" the manifold vacuum. This is the setting for maximum power and overload capacity. If economy is desired, adjust the mixing valve leaner; the manifold vacuum will drop as the mixture is leaned, and the leaner the adjustment, the lower the manifold vacuum will be.

For example, if the manifald vacuum peaks at 5.2 in. of mercury, and the mixture is then leaned until the manifold vacuum drops to 3.2 in., the exhaust will be found to contain about 4 per cent oxygen, as shown in Fig. 12. Leaner mixtures are possible but this setting gives good fuel consumption and overload capacity.

Operation with lean mixtures leaves the combustion chamber and piston top with a reddish cast, but this condition is merely the characteristic appearance and is not evidence of burning. Test shows that lean operation is in no way detrimental to an engine, and some operators believe lean mixtures are easier on the lubricating oil than rich mixtures. A possible explanation for this observation is that the lean mixture results in lower heat rejection and a lower exhaust temperature.

Optimum Spark Timing

For good combustion, spark timing must be correct. Engine manufacturers specify the optimum spark setting for their engines and these recommendations should be closely followed. However, to understand combustion we should know how spark timing affects engine performance. Fig. 14 shows how the spark advance affects fuel consumption and maximum firing pressures.

In this engine the minimum fuel consumption is obtained with 20 deg spark advance. The maximum firing pressures, however, change sharply with the spark timing, and increase as the spark is advanced. Obsiously the best spark advance is the setting that gives the lowest firing pressure consistent with good fuel consumption. This statement applies to all types of spark ignition engines.

The vacuum gauge or manometer is a useful tool in obtaining the optimum spark setting of 4-cycle naturally-aspirated engines. Manifold vacuum readings are also plotted in Fig. 14 and show that the manifold vacuum is highest when the fuel consumption is lowest. In making this adjustment, the vacuum gauge (when it can be used)

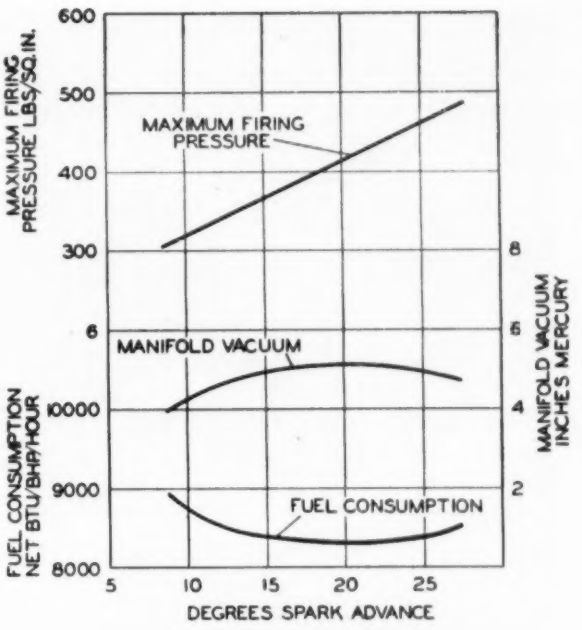


FIG.14 EFFECT OF SPARK TIMING

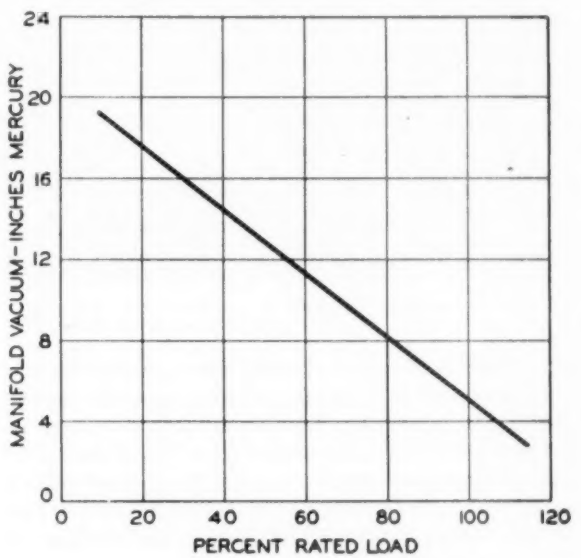
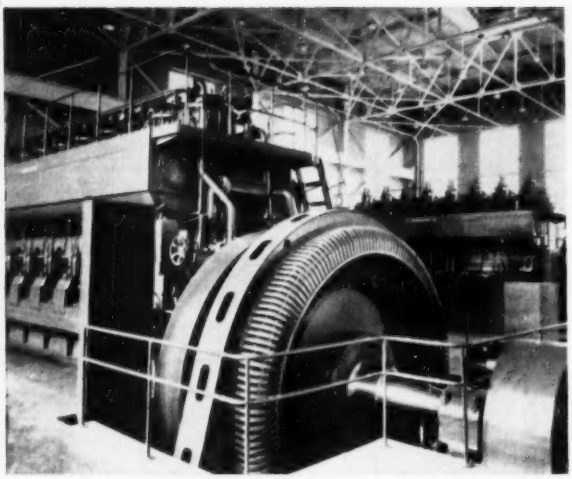


FIG.15 MANIFOLD VACUUM VS LOAD

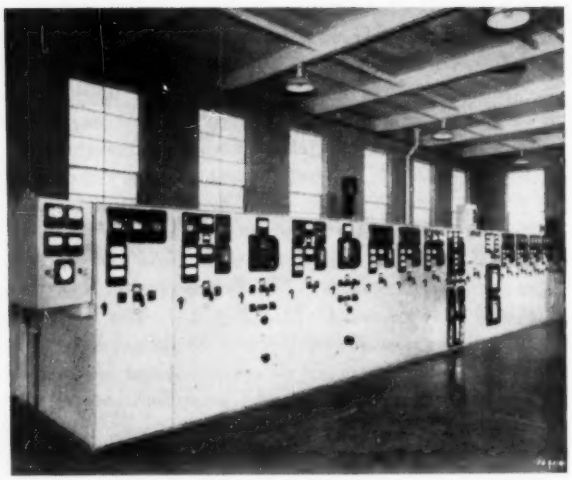
will take the place of an engine indicator and elaborate fuel measuring devices.

Manifold Vacuum and Load

While on the subject of the vacuum gauge, another use can be mentioned. Manifold vacuum is a measure of engine load as each reading of the vacuum represents a different load, as shown in Fig. 15. The actual vacuum will vary with the type of engine and compression ration, but once established for a particular engine it will provide a useful method to check operation.



Above, one of the Nordberg 2-cycle Duafuel diesel engines from the generator and control end.



Illustrated here are the main control cubicles and switchgear for the plant.

Dual Fuel Engines Cut Costs

Here is how a Texas town cut fuel bills by installing dual fuel engines in their 17,300-hp municipal plant. Savings in fuel costs—over $170,000 in a year.

THREE Nordberg Duafuel engines with a combined capacity of 9800 hp are producing power in the Denton, Texas municipal power plant for a total average fuel cost of 1.8764 mills. Installation of a 340-hp, 2-cycle low pressure gas Nordberg Duafuel diesel engine in 1950 enabled the plant to generate 94 per cent of their total output in 1951 on the gas-burning equipment with a fuel saving of over $170,000 a year.

In a typical month, the dual fuel engines consumed an average of 9.82 cu ft of gas and 0.0053 gal of pilot oil for each kwhr generated. This included fuel oil, used starting as straight diesel and then changing to dual fuel operation. The engines consistently produced power with a total fuel consumption of less than 11,000 Btu per kwhr, even when operating at times with low load factors of 35 per cent to 70 per cent.

The old oil-burning equipment has an average fuel cost of 7.348 mills per kwhr which would be improved some, of course, with a better load factor.

This busy North Central Texas city of 22,000 is the center for a prosperous agricultural area, and has a considerable number of manufacturing enterprises. It is also the home of North Texas State College and Texas State College for Women, and has operated a profitable municipal power plant for almost half a century.

In 1947 the plant was operating with seven diesel engines. The load factor was so high that when the maintenance men came to work in the morning there was only limited time for minor maintenance before the load came on. Other maintenance was done Saturdays, Sundays, and nights.

It was at this stage that city fathers began planning for the future. Old plant and facilities, even to the switchboard, were inadequate, so it was decided to build a new plant across the street and maintain the old plant for standby.

The new plant has a pleasing appearance from the outside and is efficiently planned on the inside. It is only three blocks from the Courthouse Square, which is the center of the business section. The selection of two 3200-hp Nordberg 2-cycle, high pressure gas "Duafuel" engines was the most important improvement over existing installations. These engines made possible a greatly reduced fuel cost through efficient utilization of cheap, abundant natural gas. The resultant reduction of maintenance costs

for the operation of two engines, rather than five to seven old oil-burning engines, was an important factor.

This new plant was put in service early in 1948 with one unit hooked up to a patchwork switchboard and to an outside distribution feeder that would only carry a 1300-kw load. The plant was operated in this manner until July 1948 when a new 20-unit switchboard was installed. At this time, the second unit was put into service and the first unit was switched from diesel to dual fuel operation.

The demand kept increasing (See Table I) so that by 1950, another unit had to be added. As a result of their experience with the two 3200-hp engines, the city officials ordered and installed in November 1950, a 34000hp Nordberg 2-cycle, low pressure gas Duafuel engine, which brought the total duafuel capacity to 9800 hp. The building was originally constructed with a steel rear wall, so that plant expansion was made with considerable ease.

In order to give some idea of the demand on the plant, and the scale of operations of the Duafuel units, the figures for the period January 1, 1951 to January 1, 1952 are cited:

	Kwhr	Gas-cu ft	Pilot Oil Gal	Hrs Run Time		Load
Engine A	11,099,000	215,694,000	56115	7794	89%	64%LF
Engine B	11,390,000		56546	8329	95%	62%LF
Engine C	9,420,000	95,107,000	67165	5362	61%	73%LF
	Kwhr		Pilot oil		Gas	
	3,443,000		$1473.93		$4890.40	
Cost. kw:	1.8484 mills		.4281 mills		1.4203 mills	
Total Btu per kwhr for this month was 10,482.						
	Kwhr		Pilot oil		Gas	
	2,544,000		$1215.09		$3733.31	
Cost kw:	1.9448 mills		14776 mills		1.4672 mills	
Total Btu per kwhr—10,171.						

Peak load during this period was 8200 kw and the average load, 3855 kw. Pilot oil figures for unit C are not representative since the engine operated as a straight diesel during part of its early operation. In total, the three units generated 31,909,000 kwhr while consuming 310,810 mcf of natural gas and 179,862 gal of pilot oil. With gas costing 14.09 cents per mcf, and pilot oil .09 cents a gal, the Nordberg units averaged 1.8764 mills per kwhr.

During the same period, the plant's older oil-burning diesels operated at an average fuel cost of 7.348 mills per kwhr. With a difference in fuel cost of 5.472 mills, the fuel saving with dual fuel operation is over $170,000 per year.

A study of the operating data for a typical high load month, August 1951, gives an idea of plant operation when the load factor was 67 per cent on the dual fuel engines.

December 1951, with a load factor of about 53 per cent, reveals the following results on the new engines:

While this is a lower Btu per kwhr than in August, it will be noted that the cost is higher because of the higher ratio of pilot oil to gas at the lighter load, and because the gas contract is based on a sliding scale and gets cheaper with high consumption.

During December the engine load factors were as follows:

"A" 31 per cent; "B" 32 per cent; and "C" 69 per cent, while in August the load factors were: "A" 71 per cent; "B" 66 per cent; and "C" 75 percent. The average total fuel cost for the high and low month work out to 1.8764 mills per kwhr.

In the general plant description which follows, units A and B are identical eight cylinder 21½ in by 29 in—3200-hp at 225 rpm engines using high pressure gas. Engines are direct connected to generators rated at 2250 kw at the switchboard. Unit "C" is an eight cylinder 21½ in by 31 in—3400-hp at 225 rmp engine using low pressure gas. This unit is direct connected to a generator rated at 2635 kw.

Pilot oil is hauled 35 miles from Fort Worth in the city's tank truck and stored in two above-ground steel tanks having a combined capacity of approximately 45,000 gal. From here it is fed by gravity to a day tank for each engine, these tanks being located in the basement.

Precooling and humidifying of scavenging air is accomplished by use of this Marley Aquatower.

Gas is brought to the plant through a 6 in main, at a pressure which varies from 18 to 35 lb and is passed through orifice meters and pressure regulators. Here it is reduced to 10 psi for the suction side of the 12½ in by 6 in and 3½ in by 10 in, three stage compressors which supply the two high pressure units with gas at 1200 psi. The compressors are driven by 225-hp synchronous motors at 360 rpm.

The low pressure engine is supplied gas at 17 psi. Because 16 psi is required to pull full load, and because line pressure sometimes drops to 17 or 18 psi before scrubber and regulator, it is highly important that the engine have an efficient and accurate automatic change-over device to change to fuel oil when gas pressure drops below 16 psi at the engine header.

Scavenging air is supplied to each engine by motor driven centrifugal blowers. Air is drawn through traveling oil bath filters and on the 3400-hp low pressure engine the blower discharge passes through an after cooler served by a small induced draft tower. The incoming air passes through a wet pad type "desert cooler" which not only pre-cools the air but takes out almost all the dust before

the air reaches the oil bath filter. The evaporative cooler and after cooler are only used in hot weather.

The lubricating oil circuit is the same on all three engines, oil being drawn from the sump by an attached engine driven pump, forced through duplex strainers, then through shell and tube coolers and back to the engine header. A motor driven "before and after" pump is in the circuit connected through a low pressure switch which starts the pump automatically should the oil pressure drop below safe limits.

The hot water from all three engines is discharged into a common hot well. Vertical turbine type pumps mounted on top of the hot well put the water through 12 sets of coils located in the cooling tower and back to the engines. Cooling water contains no scale-forming chemicals and is treated to prevent corrosion and pitting of metal.

Each engine is equipped with a gauge and alarm panel near the central station. These panels are supplied by Nordberg and contain all the necessary gauges, alarms and relays for pressures and temperatures for water, oil, gas, air, and exhaust, as well as indicating the load carried on the blower motor.

One advantage of the low pressure engine is its ability to switch instantly from gas to liquid fuel. This effectually prevents stoppage or dropping of load due to lowered gas pressure. This is important in Denton because the gas pressure supplied is barely over the minimum required for operation. The engine will automatically switch to liquid fuel upon failure of actuator oil pressure and will cut off gas supply upon failure of pilot oil pressure.

The engine is also operated as a straight diesel for several hours occasionally to check clearances and condition of the gas valves and during one gas shortage, the engine was operated on 30 per cent oil and 70 per cent gas for two days and nights. Both of these are very fine features of the engine, especially the ability to check and adjust when the engine is running. Few, if any, engines run on "any" desired percentage of gas-oil. This is a very important feature because if the gas pressure gets too low for full load operation it is then possible to change the oil-gas ratio in five per cent steps to any desired value that will permit the engine to pull full load with a minimum use of oil.

The switchboard is of modern design with air gap circuit breakers and has four generator panels, four generator auxiliary panels, totalizing panels, feeder panels, and a bus tie panel tied in with the old plant across the street.

The generator field switches are located near the exciters. A 125-volt bank of storage batteries is used for switchboard and sub-station operation and for initial excitation for the generators when starting so that the generator builds up voltage even when the engine is running on starting air, providing current for starting the blower motors which are connected directly to the generator leads.

The three engines and auxiliaries are handled by one operator and one helper on each shift. Operators are on duty for standby service in the old plant. A chief operator and three maintenance men take care of all maintenance as well as the maintenance on all the 10 water wells and pumping equipment for the city water supply. The operators like the ease with which the low pressure engine starts due to the absence of auxiliary equipment and compressors.

As the load increases, Duafuel engines will continue to provide the citizens of Denton with plenty of economical power while providing profitable returns to the city government.

Table I

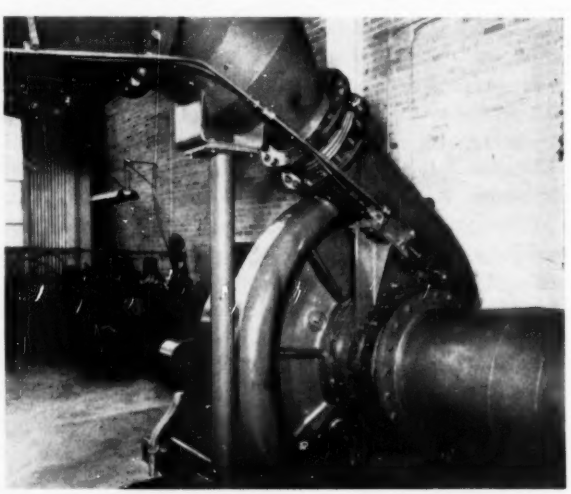
Year	Total Kwh	Average Hourly Kw	Per cent Increase	Peak Load	Per cent Increase
1944-45	14,850,400	1695		3200	
1945-46	16,436,500	1876	10.5	3650	14.0
1946-47	19,162,400	2189	10.5	4000	10.0
1947-48	22,084,760	2635	20.0	4900	22.0
1948-49	26,995,806	3080	10.5	6050	23.0
1949-50	29,772,000	3395	10.0	6900	14.0
1950-51a	30,694,400	3513	3.0	7000	1.5
1951-52b	33,766,000	3858	10.0	8200	17.0

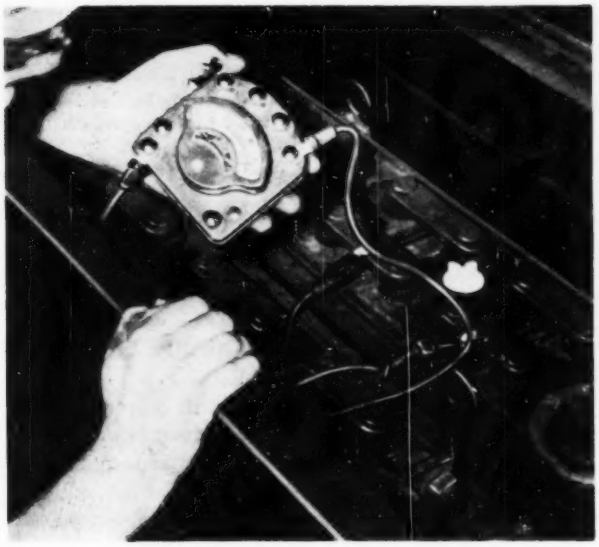
a) Slight increase caused by unseasonably cool summer.
b) Estimated. Hourly average already running 16 per cent above preceding year; expected peak in July, 1952, 9000 kwhr.

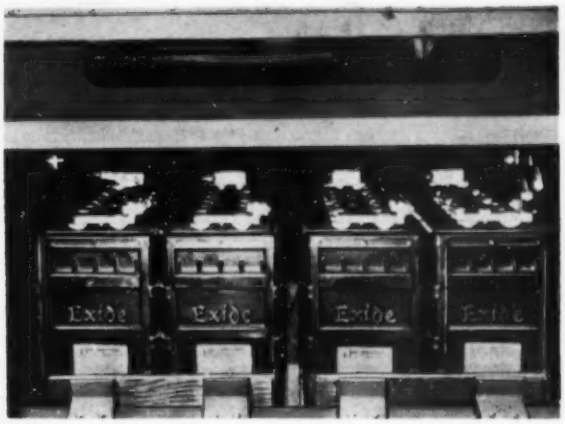
Principle Equipment

Engines ..... Nordberg Manufacturing Co.
Generators ..... Elliott Company
Governor ..... Woodward Governor Co.
Lube oil system
  Filter ..... The Hilliard Corp.
  Auxiliary pumps ..... Blackmer Co.
  Coolers ..... Struthers Wells
  Cylinder lubricators ..... Manzel Bros., Inc.
  Strainer ..... Nordberg Mfg. Co.
Intake air system
  Filters ..... American Air Filter Co.
  Exhaust silencers ..... Maxim Silencer Co.
  Compressors ..... American Brake Shoe Corp.
  Scavenging air blowers and motors ..... Quincy Compressor Co., Elliott Co.
Gas system
  Regulator ..... Fisher Governor Co.
  Compressors ..... Ingersoll-Rand Co.
  Compressor drive ..... Elliott Co.
Electrical system
  Switchboard ..... Allis-Chalmers Mfg. Co.
  Generator field switches ..... Westinghouse Electric & Mfg. Co.
  Synchronous motor starters ..... General Electric Co.
  Alarm panel ..... Nordberg Mfg. Co.
Cooling tower ..... Water Cooling Equipment Co.
Crane ..... P & H

Shown below is the scavenging air blower used on these engines. Scavenging air is controlled automatically.







Periodic checking of batteries is an important factor in adding to their life. Illustrated above are a group of batteries carefully blocked in position. It will be noted that these batteries are kept clean on the outside to prevent the entrance of any foreign matter into the cells.

Part II—Inspection and Records

Care and Charging of Batteries

By S. K. Lessey*

Batteries will give long and trouble-free life if cared for properly. Here is the second of two articles presented to better acquaint you with some of the factors involved in battery care.

How are your battery records? In many installations, there are none kept. If you are responsible for the maintenance of a number of batteries, it may be to your advantage to adapt some of the following forms for your particular use. They serve as a ready reference, indicating last inspection and any troubles found and what steps were taken to counteract those troubles.

RECORD OF BATTERY PERFORMANCE—A battery and voltage regulator inspection card should be kept in a holder on each diesel locomotive, so that desired information can be recorded quickly and conveniently. If the battery is transferred from one loccmotive to another, the card must go with it so that a continuous record of the battery's condition and performance may always be available for reference.

*Manager, Service Division
The Electric Storage Battery Company

This calls for a systematic inspection program and a carefully kept record of the battery and its charging equipment at regular inspection periods. Only in this way can proper maintenance be carried on.

Regular study of the battery record card facilitates detection of developing trouble and forestalling serious failures of the battery or the locomotive by timely application of corrective measures.

When the record is filled, a new card should replace it. All pertinent information, including the last inspection readings in the old card, should be entered on the new one. The old card then should be filed at the maintenance terminal.

Properly kept records also help maintenance personnel to uncover irregularities and promptly correct them.

ROUTINE BATTERY INSPECTION—Routine battery inspections should be made at least weekly. They require only a few minutes and should be begun immediately upon the locomotive's arrival at the inspection point. The following steps should be taken:

1 Hydrometer readings for specific gravity (before adding water). Record readings with inspection date and inspector's initials. If reading is 100 points below full charge value, give "boost" charge.
2 Check electrolyte level (before adding water) and record level or height above splash cover (to nearest 1/8 in). Water additions should be required only at monthly inspections. However, if electrolyte level is close to splash cover, add water to all cells, check reason for need, and record addition on battery card.
3 Check cell temperature by touching cover with hand. If it feels very warm, take thermometer reading of electrolyte, and record

BATTERY RECORD - DIESEL ELECTRIC LOCOMOTIVES

Date Card Applied_____ Battery Make & Type_____
Location_____ Serial or P. O. No._____
Unit No._____ Date New_____

If unit is transferred give date and new location below.

If battery is changed out before expiration of this card, explain under remarks and make out a new card. After Semi-Annual Inspection is made, forward card to office of Diesel Superintendent.

ROUTINE INSPECTIONS

DATE	PILOT CELL READINGS						INSP.	DATE	PILOT CELL READINGS						INSP.
	Right Side			Left Side					Right Side			Left Side			
	Sp. Gr.	Temp.	Sol. Hgt. In.	Sp. Gr.	Temp.	Sol. Hgt. In.			Sp. Gr.	Temp.	Sol. Hgt. In.	Sp. Gr.	Temp.	Sol. Hgt. In.	

NOTE: If battery requires water, repairs, or is not in good condition, explain in remarks.

Remarks:

Here is a typical battery record card which can easily be adapted to your needs for battery records.

on battery card. If temperature is above normal, find cause and correct it.

4 Check by touch or sight:
   a. Tray blocking
   b. Intertray and terminal wiring and all bolted connections.
   c. Tightness and condition of vent plugs.
   d. Evidence of electrolyte leakage, as from broken container, cover or loose or missing vent plug.
   e. Cleanliness of battery.

MONTHLY BATTERY INSPECTION—The purpose of monthly inspection is to see that (1) the battery is maintained in a serviceable condition; (2) charging equipment is properly adjusted; and (3) to perform necessary servicing of battery or charging equipment.

This inspection also should be made immediately upon arrival of the locomotive at the inspection point. The following steps should be taken:

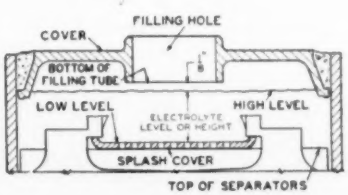
1 Take hydrometer or sp gr readings (before adding water) and record them with inspection date and inspector's initials.
2 Check electrolyte level (before adding water) and record level or height above splash cover (to nearest ⅛ in). If level has dropped more than ½ in since last previous monthly inspection, find and correct cause.
3 Check temperature of several cells by touch. If they seem warm, take thermometer reading of electrolyte and record it. Then find correct cause, making sure it is not the voltage regulator.
4 Add water to all cells and note addition on battery card with date and inspector's initials.
5 Record voltage regulator setting as found and as left, date, and inspector's initials.
6 Check visually or by touch:
   a. Tray blocking.
   b. Intertray and terminal wiring, and all bolted connections.
   c. Tightness and condition of vent plugs.
   d. Evidence of electrolyte leakage from any source.
   e. Cleanliness. Dampness around vents or elsewhere on covers usually contains some acid. Neutralize, rinse and dry.

ANNUAL OR EMERGENCY INSPECTION—In addition to routine and monthly inspections, a thorough battery inspection should be made once a year, or at any time when poor performance indicates serious trouble. This inspection is needed to ascertain that the battery has been maintained in a good, serviceable condition, and to insure it delivers satisfactory service until the next annual inspection. It is important that the following steps be taken:

1 Take hydrometer readings of sp gr in all cells (before adding water), and record readings of all cells with the date and inspector's initials.
2 Add water to all cells and record addition on battery card, with the date and initials of inspector.
3 Record voltages of all cells on charge, either at finishing rate or with engine idling. Also record the charging current amperage.
4 Record or check-mark cell numbers, sp gr and voltage readings of the highest and lowest cells in the battery. For future comparison, record electrolyte heights above splash covers (to nearest ⅛ in), electrolyte temperatures, and sediment depths in these two cells. Also record temperature of air around the locomotive. If the low cell is lower than it should be (voltage 0.20 volts below average and sp gr 40 points below highest cell), locate and correct cause.
5 Thoroughly check voltage regulator as previously described. Adjust and recheck it if necessary.
   NOTE: If possible, when installing a new battery at an annual or emergency inspection period, replace voltage regulator with a shop overhauled and adjusted spare unit.
6 Give battery and compartment a thorough cleaning.

Essential Accessories

Dependable tools and accessories will facilitate battery maintenance and



MONTHLY INSPECTIONS

ENTER LAST READING FROM PREVIOUS CARD ON FIRST LINE

DATE	BATTERY READINGS Right & Left Sides			Water Added Amt.* in Inches	GENERATOR VOLTAGE REGULATION					Place	Inspector
	Sp. Gr.	Temp.	Sol. Hgt. In.			Front Gen.		Rear Gen.			
						Idle	Run	Idle	Run		
	R				Found						
	L				Left						
	R				Found						
	L				Left						
	R				Found						
	L				Left						
	R				Found						
	L				Left						
	R				Found						
	L				Left						
	R				Found						
	L				Left						
	R				Found						
	L				Left						

REMARKS:

ANNUAL INSPECTION

Date _____ Inspector _____
Place _____

Cell	Sp. Gr.	Sol. Hgt. In.	Cell	Sp. Gr.	Sol. Hgt. In.	Cell	Sp. Gr.	Sol. Hgt. In.	Cell	Sp. Gr.	Sol. Hgt. In.
1			15			29			43		
2			16			30			44		
3			17			31			45		
4			18			32			46		
5			19			33			47		
6			20			34			48		
7			21			35			49		
8			22			36			50		
9			23			37			51		
10			24			38			52		
11			25			39			53		
12			26			40			54		
13			27			41			55		
14			28			42			56		

Temp. of Pilot Cells — Right Side, Cell No. ____, ____°F.
Left Side, Cell No. ____, ____°F.

REMARKS:

Shown above are two more sample forms for keeping record of battery condition, frequency of inspection and service.

provide more accurate readings of sp gr, temperature, and voltage. The following tools and accessories represent the minimum necessary to good maintenance:

Hydrometer—should be clean and accurate. An 18 in soft rubber extension with a bent hard rubber measuring nozzle simplifies measuring the height of electrolyte and taking readings of cells in the rear of 4-cell trays in compartments with low overhead space.

Battery Thermometer—any accurate Fahrenheit thermometer for checking temperature of liquids, preferably one showing correction to hydrometer readings for any temperature of the electrolyte.

Accurate Voltmeter—for checking cell voltages and for checking and adjusting voltage regulators. The one for checking cells should have a 3-volt scale that can be read easily in hundredths of a volt with accuracy within 1 per cent. The voltmeter for checking and adjusting voltage regulators should be accurate and well calibrated, with an open scale so that the difference between 74 and 75 volts or 129 and 130 volts can be easily read.

Voltmeter Leads—should be long enough to reach rear cells with the voltmeter at front of compartment where it can be read accurately and with ease.

Rubber or Plastic Rule—for measuring height of electrolyte.

Two 6-in Box Wrenches—for tightening bolted connectors.

Important Rules and Precautions

Do not work on battery or in battery compartment without first opening the main battery switch.

Keep all flames away from the battery.

Do not lay tools on top of battery or tap or connect any load across a part of the battery for any purpose whatever. If less than total battery voltage is needed for accessory equipment, use an adequate series resistor for reducing the total battery voltage to the value desired.

Low electrolyte temperatures temporarily reduce battery capacity. Restoration of normal temperatures brings battery capacity back to normal.

Continued and frequent temperatures above 115° F shorten battery life. Provide full ventilation in warm weather.

With proper operation, battery temperatures should not exceed temperature of outside air by more than 15° F.

Oil should not be permitted to drop on the battery. It injures the sealing compound. Oil on the battery covers, trays and sealing compound should be wiped off with a cloth dampened with carbon tetrachloride. Do not pour this liquid on cover or compound. Use it only to dampen the cloth with which oil is wiped away.

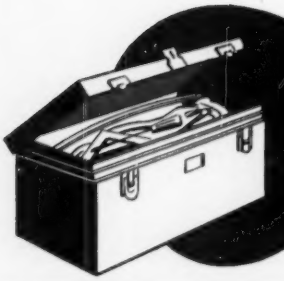
If combustion does not occur promptly when cranking the engine, do not continue to crank until the battery is exhausted. Conditions may not be just right for starting. Make sure that all necessary steps preparatory to starting have been taken. If some detail has been overlooked, or if all conditions are not favorable to starting, it is futile to continue rolling the engine at the risk of exhausting the battery.

If the battery cranks the engine and the engine fails to start, the fault lies outside the battery. Failure to start may be due to any of a number of things mechanical or electrical. For probable causes refer to the instruction book supplied with the locomotive by the manufacturer.

The foregoing recommendations and instructions, if followed carefully, provide the basis of an efficient maintenance program which should result in better battery performance and longer battery life.

Do You Need Trained Diesel Men ?

A card to DIESEL POWER AND DIESEL TRANSPORTATION will bring you our listing.



Straight from the Tool Box

This is YOUR Department. Pass along your ideas to the other fellows. Send items to the Editor, preferably with a picture or sketch. Contributors will receive $10.00 for each item upon publication.

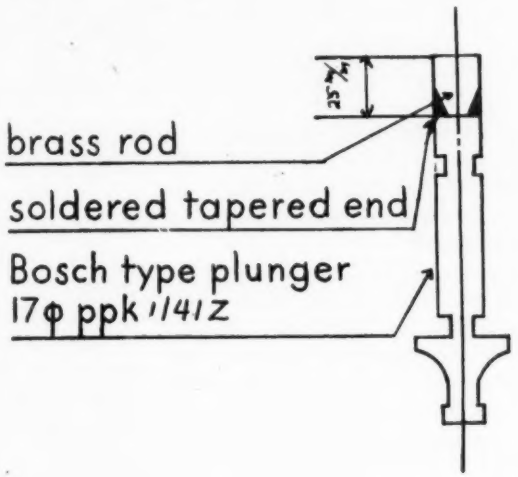
Plunger Reclamation by Chroming

TARO KOHAMA, OSAKA, JAPAN—In my fuel injection service depot, I have equipment for hard chromium plating. I use this to repair equipment in special cases and when replacement parts are not available. Eroded and corroded plungers have been successfully repaired.

The first step is to lap off the eroded surfaces completely. The surfaces are then restored by chromium plating. However, hard chromium has a tendency for heavier deposition on the edge of the plunger head than on other surfaces. I can make other surfaces sufficiently uniform by placing the plunger accurately at the central axis of the plating equipment.

This thickening of the deposition on the edge has been overcome as follows. In this example, a Bosch PE type plunger is used. A 25-mm brass rod (the length was determined experimentally), with the same diameters as the plunger, is tapered at one end. This end is soldered to the plunger head as shown. The solder and rod are smoothed to the diameter of the plunger.

When plating, the tendency for heavier deposition is shifted from the edge of the plunger to the upper edge of the brass rod. In this way, I have been able to get perfectly uniform plating on the plunger.



Once again, we bring you an item as a matter of interest to show what can be done. While this process might conceivably be practical for a mass reclamation project, it certainly would not be practical or economical in the case of a few units. It is too easy to get replacement parts these days. It does show what other people are up against, and the ingenuity used to solve their problems. We have seen the use of "decoy" surfaces before, but not in this application.

Incidentally, we have never been successful in soldering brass to steel unless it was copper plated (flash coating). Wonder how he does it. Also, what about the edges of the helix and annulus? Must these voids be filled? Perhaps Mr. Kohama will write and tell us at some future time.—Editor.

Removing Studs, Taps and Keys

W. E. WARNER, WOODFORD GREEN, ESSEX, ENGLAND—The method of withdrawing studs described in the June issue was a good one. It can also apply to removal of broken taps. There is, however, possibility that the heat of the welding will cause them to bond with the base metal.

In the case of taps, this is easy to avoid by using a mixture of graphite and oil. The mixture should be fairly stiff but capable of some slight liquid flow. It is pushed down the flutes of the tap and coats the portion of the tap below the washer. This will prevent the possibility of welding mentioned.

Another method can be used when a torch is not available. This method also dispenses with the washer. The nut is placed on the tap as before, but is attached by using an iron cement. When this sets, there will be a strong joint and the tap can be screwed out.

This cement can also be used for removing keys. These are often difficult to remove, particularly in confined places. A steel bar about a foot long and slightly smaller than the key width is selected. Both the end of the key and the bar are roughened with a knurl or center punch. Iron cement is applied and the two forced together. More cement is smeared around the joint for strength. Once the cement has set, the joint is usually strong enough for the key to be drawn out.

Sounds O.K., but we haven't kept up on our adhesives. How strong are these cements? What about some comment?—Editor.

On the Mesabi Range this 20-tonner hauling iron ore is a Walter Dumper powered by a Waukesha Super-Duty Six 6-WAK Butane Engine

WAUKESHA Super Duty Six

1197 CU. IN. 6-WAK SERIES ENGINES

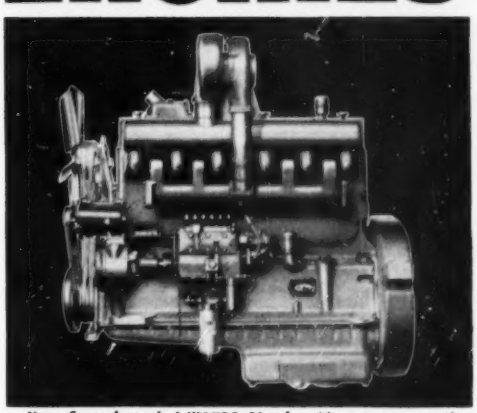
includes

- **6-WAK—Butane Engine**
- **6-WAK—Gasoline Engine**
- **6-WAKD—Diesel Engine**
- **6-WAKDS—Supercharged Diesel Engine**

UP TO 352 MAXIMUM HORSEPOWER

Standard or Counterbalanced Crankshafts Available.
Consult Waukesha on permissible speeds for your service.

Send for Bulletins.



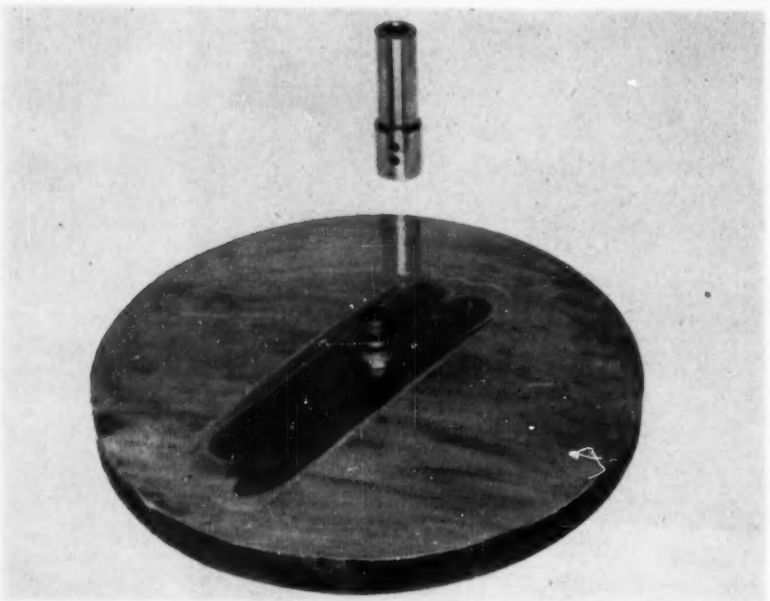
New Supercharged 6-WAKDS Diesel, with center-mounted turbocharger; 6-cyl., 6¼ x 6½, 1197 cu. in., 352 max. hp.

WAUKESHA MOTOR COMPANY • WAUKESHA, WISCONSIN

NEW YORK TULSA LOS ANGELES

193

New Products



Flat Lapping Kit

Do your shop operations include flat lapping? If they do, here is a compact kit recently developed by the Scintilla Magneto Division in order to facilitate lapping of their injection equipment and other flap lapping operations.

The kit consists of one 10-in and two 3-in lapping plates, and two containers of lapping rouge. One box contains flat lapping rouge (yellow) and the other, finishing or cylindrical rouge (green). Complete instructions are furnished with the kits for their preparation, use, and also instructions for cylindrical lapping.

When the plates become worn or accidentally damaged, they may be returned to the factory for regrinding. The illustration above shows the 10-in plate in use.

Air Line Moisture Indicator

King Engineering Corp., Ann Arbor, Mich. announces an air line moisture indicator, for use in air or gas lines, to give visual indication of the presence or absence of moisture in the line.

The unit consists of a pyrex glass cylinder filled with moisture-sensitive blue granules, and has end plates tapped for ¼-in pipe. In operation, it is placed in the line between the air supply and the point at which the air is used. The granules stay blue as long as the air is dry and turn pink when it contains moisture or water vapor.

Four tie rods protect the cylinder against damage and permit disassembly for recharging. All units are factory tested at 100 psi pressure. Indicators with plastic cylinders can be furnished for higher pressures. Dimensions are 5 in long by 2 5/16 in sq. Pressure drop is less than 1 in of water at a flow rate of 5 cfm.

New Dual-Purpose Oil

A new dual-purpose oil, functioning both as a lubricant and as a preservative, has been developed by the Texas Company.

Texaco research experts carried out investigations into such factors as humidity, condensation, corrosion, and related phenomena. The resultant product combines special additives developed to ensure maximum preservation of internal combustion engine surfaces with motor oil additives of the type used in heavy duty lubricants. shipment, it has proved useful in en- In addition to application for engines gines in intermittent service such as stationary engines and engines in farm vehicles.

New Electronic Stethoscope

A new portable electronic instrument for locating sources of trouble in all types of machinery has been announced by Anco Instrument Div., 4254 W. Arthington St., Chicago 24, Ill. Called Elec-Detec, the stethoscope saves maintenance time by locating friction noises in bearings, pistons, gears, ratchets, cams, clutches, and other parts, it is stated.

The instrument uses a metal probe which serves as a microphone. Sound impulses are transmitted through an amplifier to head phones. Sounds can be detected at low speed, it is claimed, which otherwise would be heard only at high speeds. It is furnished complete with batteries and leather carrying case.

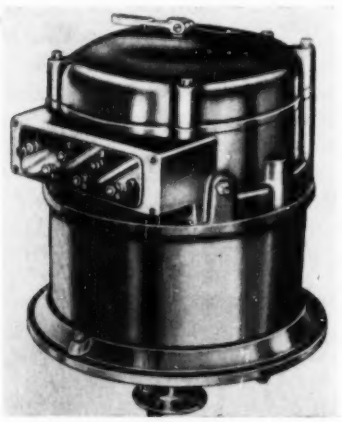
American Bosch Develops New Pulse Generator

The American Bosch Corp., Springfield, Mass., announces a new long-lived ignition system based on its development of a new design of pulse generator. The new system, according to the company, makes possible more efficient operation of high-compression natural gas engines and is capable of producing output potentials up to 30,000 v while allowing engines to run at least six months without shutdown, even for inspection of spark plugs.

Designated the MGC, the new generator is a comparatively large unit, about 11¼ in. in diam, standing about 12½ in above its mounting. It supplies timed low tension electrical pulses which are stepped up to the re-

quired spark potential by means of single or double ignition transformers mounted on each cylinder near the spark plug.

No breakers are in operation during running and no distributor is employed. Breakers are used only for starting and are automatically retracted during normal engine operation. At operating speeds the rotor and two ball bearings are the only moving parts. At cranking speeds, the generator performs as a conventional large magneto. Use of breakers during cranking makes high spark available.



The magnet rotor is a built-up assembly consisting of a single large Alnico V magnet with laminated pole shoes. Two heavy-duty, sealed ball bearings support the rotor. The laminated stator assembly is positioned between a flanged, cast iron drive end housing and a cast iron rear housing. The break plate is mounted on the rear housing.

The individual coil leads are carried to a terminal plate. The breaker lift plates are retracted from the cam by a control plate actuated by an arm mounted on the breaker cover. A spring return holds the breakers in inoperative position for normal running. Either gear or coupling drive may be used.

Thread Rolling Machine

A new model, 300 Prutton "Rollmaster" has been introduced by D. H. Prutton Machinery Co., 5295 W. 130th Street, Cleveland, Ohio.

The machine rolls 19,440 pieces per hour class 3 fit threads in ½-in, 13 hollow set screws of S.A.E. 1035 steel. The machine is said to perform comparably on either hollow or solid work in a wide variety of metals ranging from nonferrous to hardened and stainless steels.

A development of the company, the "planetary die" principle reduces rolling pressure by distributing it evenly over 30 in of die length. Pieces are hopper-fed, and roll at close intervals around the die. The larger number of pieces in work at a time make possible slower die speeds, less wear and proportionate extension of die life.

New Voltage Tester

A voltage tester having only one test lead and other new design features is announced by Holub Industries, Inc., 413 DeKalb Ave., Sycamore, Illinois. Called the "Hi-Test", it indicates AC or DC voltage from 115 to 600 volts.

The second test prod is permanently

here's the "OUNCE OF PREVENTION" for your Engine

It's better . . . and more economical . . . to prevent engine damages than to repair them! That's why your engines *need*, and should have. the protection of PENN Safety Controls.

And even the best engines can develop minor troubles in lubricating and cooling systems which can lead to engine damage. But, with the PENN Safety Control on the job, such damage is avoided.

Learn more about this low-cost protection for *new and old engines*. Three models are available: one for oil pressure, another for water temperature, and a combination pressure and temperature unit. Write **Penn Controls, Inc., Goshen, Indiana.** Export Division: 13 E. 40th Street, New York 16, N. Y., U. S. A. In Canada: Penn Controls Limited, Toronto, Ontario.

Typical Functions of PENN Safety Controls

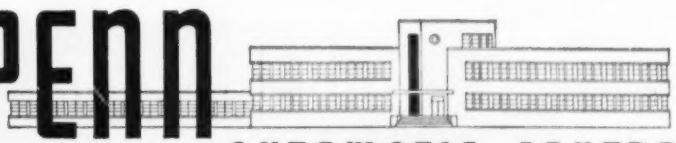
Diesel Applications. Sounds an alarm . . . closes magnetic fuel valve and sounds alarm . . . closes magnetic fuel valve only . . . closes magnetic fuel valve and opens pilot relay.

Battery Ignition Applications. Opens battery circuit and sounds an alarm . . . sounds an alarm only . . . opens battery circuit only.

Magneto Ignition Applications. Sounds an alarm only . . . grounds dual magneto . . . grounds magneto only . . . grounds magneto and sounds alarm or lights signal light.

Dual Ignition Applications. Opens battery circuit and grounds magneto.

PENN



AUTOMATIC CONTROLS

FOR HEATING, REFRIGERATION, AIR CONDITIONING, PUMPS, AIR COMPRESSORS, ENGINES, GAS RANGES

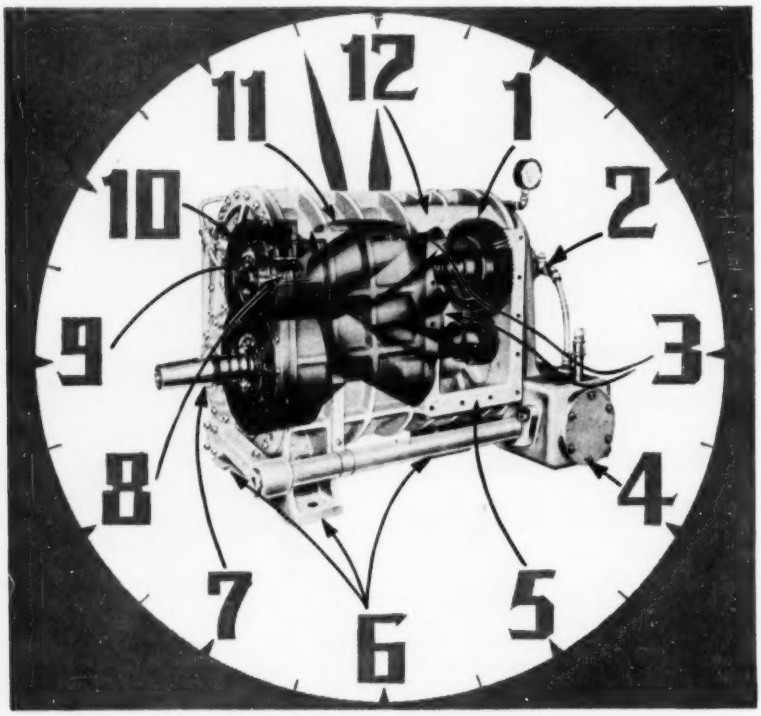
Design Features that make STANDARDAIRE *Tick around the clock*

1. Helical Gears of heat treated alloy steel hobbed and shaved to extreme accuracy for quiet operation.

2. Pressure Lubrication System provides positive lubrication to all bearings and gears.

3. Axial Air Flow . . . the smooth, gradual delivery of air minimizes shock and sound pulsations . . . it's different in theory and performance.

4. Oil Reservoir at the suction end of the blower helps to reduce oil temperature . . . holds adequate supply of oil.



5. Adapter Plates are furnished with one of a multiple of standard drillings for different pipe sizes.

6. Three-Point Mounting eliminates distortion of housing . . . facilitates application.

7. Tapered Drive Shaft for accurate and positive connection of coupling or pulley.

8. Non-Wearing, Non-Leaking, balanced pressure labyrinth seals assure clean air at all times.

9. Anti-Friction Bearings with special thrust provisions assure long life under desired load and speed requirements.

10. Self-Centering Bearing Carriers prevent housing warpage and fix the clearance between rotors and housing.

11. Rigid Shape Screw Type Rotors pull the air in gently and squeeze it out evenly and quietly . . . designed for maximum pressures.

12. One-Piece Housing for strength, accuracy and stability of dimensions.

These Standardaire Blower features, time-tested in varied applications, assure superior performance and dependable operation. For further data write

Read Standard Corporation, Dept. F31,
370 Lexington Ave., New York 17, N. Y.

AXIAL FLOW STANDARDAIRE BLOWER

BLOWER-STOKER DIVISION

READ STANDARD
CORPORATION

NEW YORK • YORK • LOS ANGELES

mounted in one end of the tester, making it easy to hold the tester in one hand and still press prod firmly against contact or wire. The voltage scale is located in the end of tester, opposite the prod, and always in full view. The drum-type scale is covered and protected with a magnifying lens.

Flashover between ends of the solenoid coil is completely eliminated in this design, as the wires are brought out of the case at opposite ends of the coil. A safety ring around end of prod handle prevents fingers from slipping off and touching the prod.

Mechanical Ear Protector

The Sigma Engineering Co., 1491 No. Vine St., Los Angeles 28, Cal., announces an improved version of its mechanical ear protector. A new silicon rubber tip replaces the original gum rubber tip, and is softer and more comfortable to wear. It will endure extremes of heat and cold and is more resistant to skin oils.

The Ear-Valv acts as a protective ear drum by removing harmful loud noise while allowing the ear canal to receive air and permit hearing of ordinary voice-level sounds. A tiny cylinder contains the controlling mechanism.

Knee-Action Caster

The All Steel Welded Truck Company, Rockford, Illinois, announces a new knee-action, shock-absorbing caster for a variety of handling applications. The company claims it may be used to replace present wheeled equipment as well as with equipment designed for it. All standard wheels are interchangeable.

Reports by the company announce large savings in caster and tire maintenance, replacement, and decreased

product damage. Shimmy or fishtailing is eliminated because wheels are kept in constant contact with the floor.

Deflection is more than 2-in in the 10 and 12-in sizes, and more than 1½-in in the 6 and 8-in sizes. The knee-action has lifetime lubrication and there is only one moving part. Springs are fully enclosed. Rated standard capacities are available in small steps from 50 lb or less, to 1500 lb or more, per caster.

Right Angle Gear Drive

Of interest to power plants is a new right angle gear drive now available from Johnson Gear & Mfg. Co., 8th and Parker Sts., Berkeley 10, Cal., offering a wide application as a "connecting right-angle unit" of power transmission for various types of processing equipment.

The unit makes possible more compact installations, eliminating belt transmissions and is adaptable with either horizontal or vertical prime movers. The unit is dust and weather proof. Installations are varied for power units from 15 hp to 450 hp. There is a wide selection of types, sizes, and ratios with adaptability in dual, multiple or combination operation.

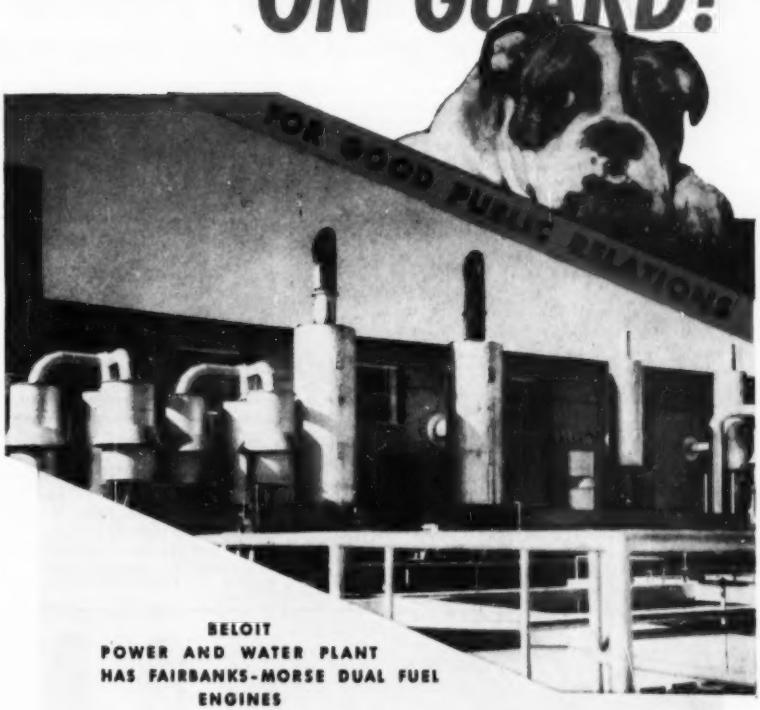
New Tool Holder and Boring Adapter Fits All Lathes

A new tool holder, with component boring adapters, to fit all standard engine and turret lathes has just been introduced by the Kirkelie Co., 8717 Darby St., Northridge, Cal.

The following claims are made for

MAXIM SILENCERS

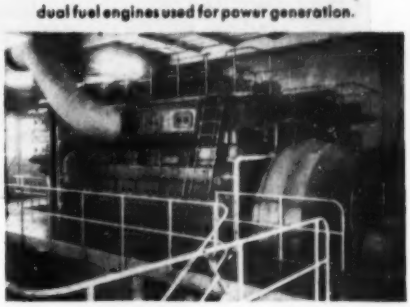
ON GUARD!



BELOIT
POWER AND WATER PLANT
HAS FAIRBANKS-MORSE DUAL FUEL
ENGINES

The new power plant at Beloit, Kansas, is a quiet and good neighbor, 24 hours a day, because of the Maxim Silencers shown above. Illustrated are four exhaust silencers, and behind each of the two-unit oil bath filters a Maxim intake silencer quiets the scavenging air inlet. The larger exhaust silencers serve the two new engines, and the smaller silencers the two older engines. In any municipal plant, good silencing means good public relations. If you have a silencing problem, let Maxim's long experience in this field solve it for you.

The two new 2000 h. p. Fairbanks-Morse dual fuel engines used for power generation.



Consult MAXIM

THE MAXIM SILENCER COMPANY
93 Homestead Ave., Hartford 1, Conn. Dept. W.L.
Gentlemen:
Please send me your bulletins on Exhaust and Intake Silencers.
Name _____
Company _____
Address _____
_____

22MX52

WESTON TAG

Thermometers

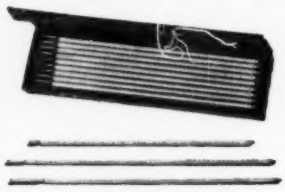
in all forms—ranges—stem lengths—connections

Whether your requirement calls for certified laboratory thermometers . . . or rugged all-metal industrial types . . . or thermometers for remote reading . . . you'll find *exactly* what you require in the Weston-TAG line—*the most comprehensive line of quality thermometers ever offered by ONE manufacturer.* Literature on request. WESTON Electrical Instrument Corporation, 617 Frelinghuysen Avenue, Newark 5, New Jersey.

Laboratory

ALL-METAL

—have readable, dial-type scales and corrosion-resisting stainless steel stems—stem lengths from 2" to 24"—ranges from low as −100°F. to high as 1000°F.—accuracy ½ of 1% of thermometer range.



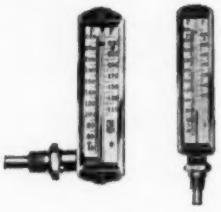
GLASS

—certified sets of ASTM Testing thermometers with overlapping ranges in protective case. Ranges from −36°F. to high as 760°F. Also precision and standard etched stem thermometers for general testing.

Industrial

ALL-METAL

—provide unmatched readability and durability—accuracy within 1% of thermometer range. Available in all types, ranges and stem lengths (2½" to 72") for all requirements.



GLASS (Metal Case)

—available in all forms, all ranges, stem lengths and connections. Accuracy within one scale division. Also submarine types, metal and cupcase thermometers.

Remote Reading

ELECTRICAL

—resistor bulb sensing element permits mounting indicator any distance away from point of measurement. *Multiple* remote readings also possible by use of selector switch and several bulbs.

PRESSURE ACTUATED

—for remote reading, in 5, 6 and 8" dial sizes. Ranges from low as −325°F. to high as 1000°F. Accuracy one scale division unaffected by vibration or severe shock. Cases of iron, brass, or plastic.

WESTON *Temperature Instruments*

— TO INDICATE — RECORD — CONTROL

9413

the product: vertical adjustment of tool bits can be made without moving of bits in their holders; no shims are needed for height adjustment of tool bits; positive repeating is made possible with unlimited number of tool bits or operations; tool bits can be removed with holder adapter for resharpening without changing set-up; tool bars are removed vertically, eliminating necessity of moving the carriage back, saving production time; and close tolerances can be held easily because the new unit repeats within 0.0003 in.

New Literature

Columbia Volt-Ammeter Folder

A descriptive folder on the new AC-1 volt-ammeter developed by the Columbia Electric Mfg. Co., 4519 Hamilton Ave. N.E., Cleveland 14, Ohio, has just been issued.

The folder gives specifications and application on this dual-purpose instrument which measures both volts and amperes and is easily operated with one hand.

Electric Pre-Heater

With cold weather upon us, the Kim Hotstart Mfg. Co., West 917 Broadway, Spokane 1, Wash., announces availability of literature describing Kim Hotstart, an electric preheater for engines.

The device plugs into any electrical outlet, and through percolator-like action, keeps the engine ready for instant starting even in sub-zero weather. The attachment is said to effect substantial economies in warm-up time, engine wear and maintenance, battery-life, fuel consumption, and storage space. Typical installations are shown and specifications listed for various sizes and types of engines.

Locknut Brochure

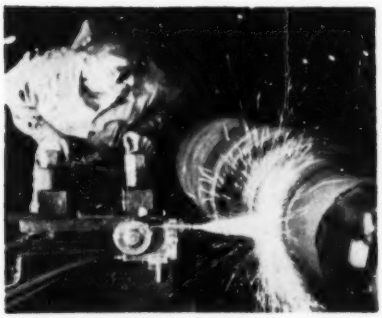
An illustrated catalog, published by the Industrial Fasteners Institute, 3648 Euclid Ave., Cleveland 15, Ohio, and listing the various companies for each type of locknut, is being presented as a guide to assist users in selection.

A detailed picture of the various types are given, with full description of operation principles and application.

Metallizing Applications Film

A new 16 mm sound film in full color, recently compiled by the Metallizing Engineering Co., Inc., 38-14 30th St., Long Island City 1, N.Y., describes the metallizing process and shows a wide range of practical applications. Each scene is taken in the plant of a metallizing user.

Maintenance departments are shown metallizing worn or damaged machine parts. Latest methods of surface preparation are demonstrated, as well as the use of metallized aluminum and zinc for the protection of iron and steel equipment and structures against corrosion.



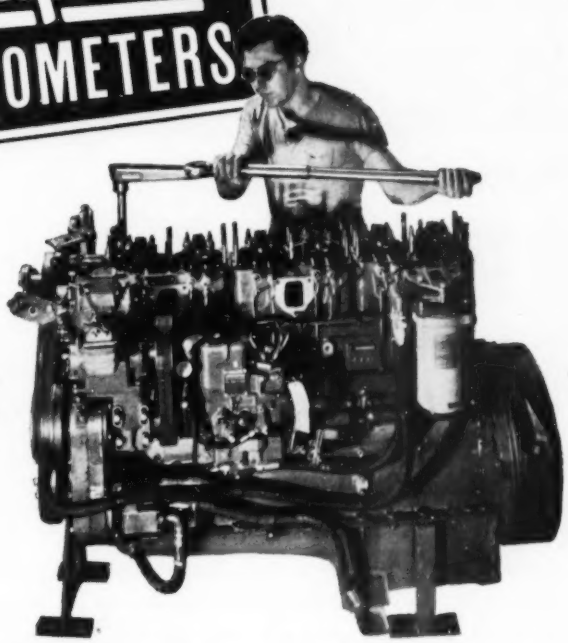
A wide range of actual metallizing work being done on worn and damaged cranks, shafts, inside diameters of different parts, press fits, are shown. One of the jobs demonstrated in a large steel mill involves the restoration of backup rolls which would have cost $125,000 each to replace.

Illustrated, is a work roll journal (21 in by 84 in) being sprayed with Metocloy No. 2, at U. S. Steel Homestead Div., East Pittsburgh, Pa. The work roll, used in a tin mill, is worn down and is being built up to size.

Lanova Corporation Publishes New Diesel Combustion Handbook

The second edition of *The Lanova Combustion System for Diesels* has been released by the Lanova Corporation, 38-15 30th St., Long Island City 1, N.Y. The 58-page, illustrated booklet, describes in non-technical terms, the principles of the internal combus-

Cummins® Diesels
ARE PRECISION TENSIONED WITH
Snap-on* TORQOMETERS



Each Cummins Diesel is built not once, but twice.

One of the big reasons for the high reputation of Cummins Diesels is the *extra* care Cummins uses in building its engines. For example, each Cummins Diesel is run in after assembly, then completely disassembled for reinspection. Then it is carefully reassembled and tested again. In *both* assembling operations, Snap-on Torqometers are used to assure complete accuracy of tensioning.

When precision machinery is assembled with bolts, mechanical distortion and excess wear of moving parts often occur if bolts are tightened to unequal or improper tension. To insure correct bolt tensioning, use Snap-on Torqometers . . . accurate as a watch, yet so easily read that even inexperienced workers can use them.

Snap-on Torqometers are built in 15 standard models, capacity from 0 to 30 inch-pounds up to 2,000 foot-pounds. At-your-elbow service from factory branches in 42 important industrial centers. Write for the Snap-on Industrial Catalog and the 104-page General Catalog of more than 4,000 Snap-on hand and bench tools for production and maintenance.

SNAP-ON TOOLS CORPORATION
8064-K 28th Avenue
Kenosha, Wisconsin

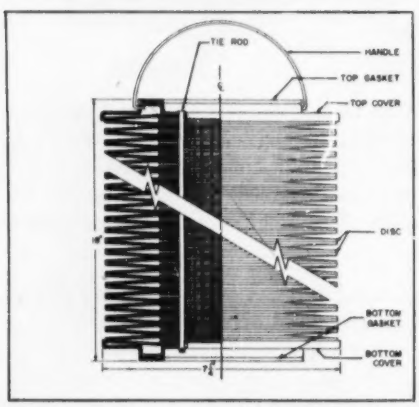
*Snap-on is the trademark of Snap-on Tools Corporation

your "Specs" Built the

FLOmaster HOFFMAN'S New FULL-FLOW FILTER

- **removes lube oil abrasives down to 20 micron size, or smaller**
- **low initial pressure drop (only 5 psi, with 150 SSU oil)**

WRITE for Bulletin A-873



New, Patented FLOmaster Cartridge is a Glutton for Dirt, A Bear for Work

Diagram, above, shows the compact arrangement of paper disc assemblies which pack 45 square feet of filtering area into each FLOmaster cartridge — a new high! You're assured dirt removal for longer periods, longer service between replacements.

To meet your requirement for *full* protection of bearing surfaces against engine wear, Hoffman has designed this new-full-flow FLOmaster. Removes abrasive particles at high flow rates, with minimum pressure loss, by means of exclusive patented FLOmaster cartridges. In each 7" x 18" cartridge is filtering area of 45 sq. ft. to provide unmatched dirt-holding capacity, longer useful life between changes.

Your choice of ten sizes, with flow rates from 75 to 900 gpm. All available with the Hoffman unique cover-lifting feature that simplifies and speeds cartridge replacement. Write for new FLOmaster bulletin A-873 *now*.

INDUSTRIAL FILTRATION DIVISION

U.S. HOFFMAN MACHINERY CORPORATION

214 LAMSON STREET, SYRACUSE 6, N. Y.

CANADIAN PLANT: CANADIAN HOFFMAN MACHINERY CO., LTD., NEWMARKET, ONT.

tion engine and explains the Lanova controlled turbulence combustion system.

Arranged in a step-by-step progression, the booklet concludes with an appendix of useful engineering information. It is being offered without charge to all who are interested.

Nordberg Radial Engines

Publication of a new three-color, 20-page bulletin on the design, operation and application of their radial engines has just been announced by the Nordberg Mfg. Co., Milwaukee 1, Wis. Bulletin 200 contains a description of the radial design and discusses cost and maintenance.

Diagrams and data explain the fuel injection and combustion systems, along with photographs of typical installations and a schematic drawing of the lubrication system. The engines are of the two-cycle type and are built with 11 or 12 cyl of 14-in bore and 16-in stroke, ranging up to 2125 hp or 1500 kw at 400 rpm.

How to Operate a Lift Truck

Available to users of fork lift trucks and industrial tractors is a manual for training operators. Titled, *How to Operate a Lift Truck*, the 24-page booklet was prepared and published by Hyster Co., 2902 N. E. Clackamas St., Portland 8, Ore.

The book combines a two-color cartoon technique with a detailed manual approach and not only gives information on the operation of a lift truck, but also preventive maintenance, safety, and basic materials handling. Drawings for setting up an obstacle course are included. Material is slanted to both the beginner and experienced operator.

Wrought Iron Data

The A. M. Byers Co., Pittsburgh, Pa., has prepared a four-page bulletin containing the most frequently required data on wrought iron pipe and plate, for the aid of engineers serving the railroad industry.

Size and dimensional data for both standard and extra strong pipe are listed, including: size; interior and exterior diam; thickness; wt per ft;

threads per in; mill test pressures; transverse areas and circumference; length per sq ft of surface area; external area per lin ft; length per cu ft of vol; gal per lin ft; and wt of water per lin ft of pipe length.

Diam and lengths of couplings are shown and data on size, shape, and thickness of wrought iron forging billets is included. A breakdown is given of standard applications of wrought iron in the railroad industry, with a brief description of some specific uses.

Hydraulic Torque Converters

The Torcon Corp., 1197 W. 5th St., Ashtabula, Ohio, have released a new illustrated bulletin, No. TC-649, which describes their line of hydraulic torque converters for medium-heavy application. The new publication features a unit size selection chart based on engine rpm and net hp as well as information on the purpose, application, construction, and operation of these converters.

The transmissions described are single-stage, three-element type units which combine a hydraulic torque converter and a hydraulic coupling, retaining the advantages of both. Ranging from 11 to 26 in, in wheel diam, they can be used with engines rated from 30 to 600 hp. Size selection can be based on such factors as application, work cycle, and engine life, as well as rated hp and speed of engine.

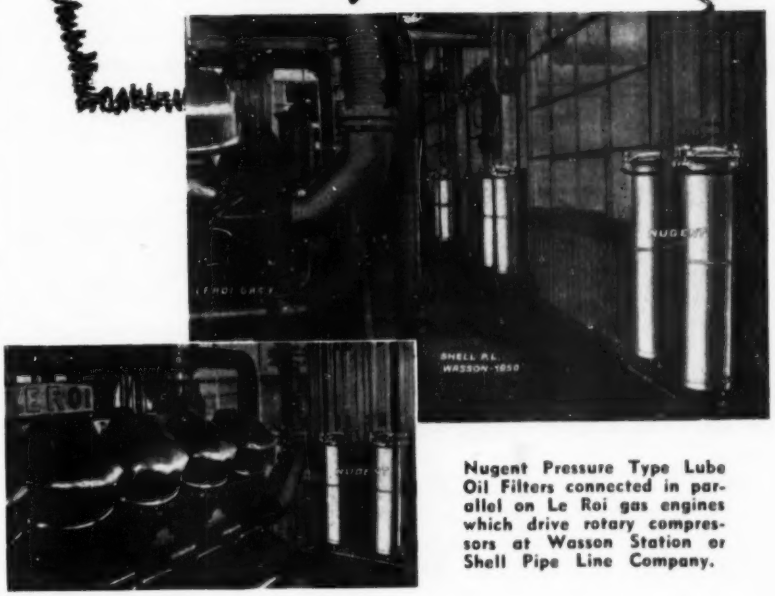
Photographs of several types of equipment utilizing the converters are included along with close-up views showing them mounted on the engines of the machines.

New Frame Type Pump Bulletin

The Allis-Chalmers Mfg. Co., 1322 So. 70 St., Milwaukee, Wis., have released a new bulletin describing their frame type centrifugal pumps designed to handle pumping jobs requiring capacities up to 500 gpm and heads as high as 135 ft.

Built for V-belt drive, the pumps can be mounted in a variety of positions and connected to any type of prime mover. Cross-section diagrams of the three available types are shown, together with performance curves.

DIRTY LUBE OIL
can't get into these engines...
They're *Nugent* protected



Nugent Pressure Type Lube Oil Filters connected in parallel on Le Roi gas engines which drive rotary compressors at Wasson Station of Shell Pipe Line Company.

THE lubricating oil used in these gas engines is always clean. Why? Because six Nugent pressure type lube oil filters are always on the job filtering out impurities. They remove 99.8% of the dirt, carbon and other foreign matter that gets into the oil permitting a constant flow of clean oil to all vital engine parts.

Filtering like this assures more efficient machinery operation. Nugent Filters, are designed to provide 20% more filtering area than any other filter of comparable size. They utilize inexpensive "Throway" recharges. Installation is simple and maintenance nil except for recharging.

For gas engines, compressors, diesel engines, Nugent filters will give you longer equipment life, less maintenance and greater oil savings. Tell us your filtering problems and we will send you full details on the Nugent filter that best suits your needs.

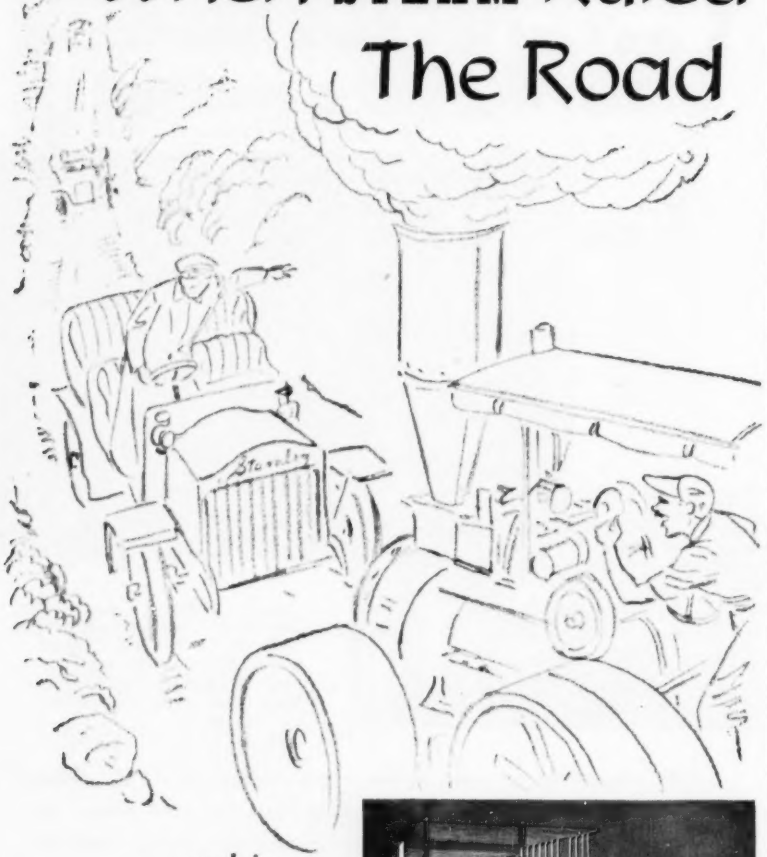
NUGENT TRADE MARK

Wm. W. *Nugent* & Co., Inc.
417 N. Hermitage Ave. CHICAGO 22, ILLINOIS

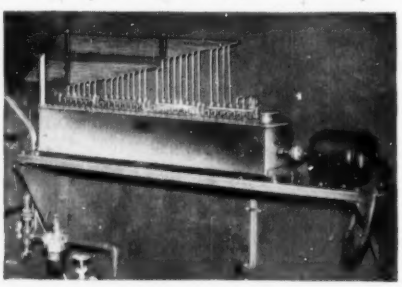
Established 1897

OIL FILTERS, OILING AND FILTERING SYSTEMS, TELESCOPIC OILERS
OILING DEVICES, SIGHT FEED VALVES, FLOW INDICATORS

When STEAM Ruled The Road



... and in modern industrial plants



In the day of the Stanley Steamer, Manzel Oil Pumps were essential to dependable performance of automobiles and steam traction engines for road building, farming, and construction. Today they are even more vital in presses, engines and other industrial machinery... saving oil, reducing "down-time"— adding years of trouble-free service. Insist on Manzel-lubricated machinery. For further information write Manzel, 271 Babcock Street, Buffalo 10, N. Y.

Manzel FORCE FEED LUBRICATION

A DIVISION OF FRONTIER INDUSTRIES, INC.

Expansion Joints Catalog

The recently redesigned line of Flexon expansion joints is featured in a new, 16-page, illustrated, two-color catalog, released by Flexonics Corp. (formerly Chicago Metal Hose Corp.), 1369 So. Third Ave., Maywood, Ill. Complete specification and supporting data are given.

Also covered are complete specification and application information for CMH corrugated and convoluted types of flexible metal hose, including couplings, flanges, nipples, and assemblies. Installation instructions are included.

Liquid Polymer

The Thiokol Corp., 784 No. Clinton Ave., Trenton, N.J., have prepared an illustrated folder describing the properties and suggested applications of their Thiokol Liquid Polymer, a viscous liquid which converts to a tough, solvent-resistant rubber at room temperature.

Railroad Wiring Materials

The National Electric Products Corp., Chamber of Commerce Bldg., Pittsburgh 19, Pa., has just issued a 60-page catalog on railroad wiring materials covering installations in diesel locomotives and diesel maintenance shops. The catalog illustrates and describes the company's line of wires and cables in the 600-v range, and the 600-v and 1000-v diesel locomotive control wire.

Liquid Filter Bulletin

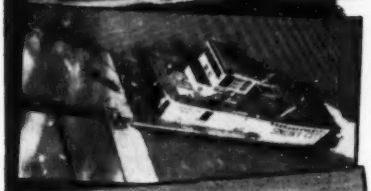
The Dollinger Corp., 11 Centre Park, Rochester 3, N. Y., have issued a new 12-page bulletin describing their liquid filters. The bulletin contains specifications, engineering and performance data, photos and descriptions of recommended types of filter media, and a check list of liquids that can be filtered.

A new feature of this bulletin is a bound-in data sheet to be filled in by the prospect. The reverse side provides room for sketches and diagrams of proposed installations. The sheet may be removed and mailed to the manufacturer, saving time and unnecessary correspondence.

Lives and Livelihoods DEPEND on S-N GEARS

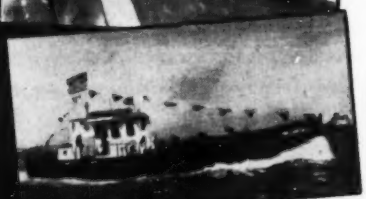
for DEPENDABLE POWER TRANSMISSION

"We take great pride in our boat and equipment," says Fra .k Ivanovich, an owner of the "Maria Rose." First of the unlimited Alaskan Seiners with S-N Gears, it is now in its 4th year of flawless service. A 150 H.P. Lorimer Diesel, and S-N Gears with superior cone type clutch, was their choice.



for DEPENDABLE MANEUVERING

"For river and towing work, S-N Gears make a boat more dependable than with two-way engines," states Glenn M. Crain, owner of the "Smoky City," Pittsburgh. This stern paddle wheeler's Caterpillar Diesel is complemented by S-N air-controlled Gear that transmits power instantly and simplifies maneuvering.



for DEPENDABLE PERFORMANCE

"Tide work around wharfs makes it necessary to have a dependable reverse gear on our 135 H.P. Murphy Diesel," says R. A. MacLean of Harbor Supply Oil Co., owner of "Portland Gulf." S-N's balanced gear train assures long, trouble-free service under every condition.

MANUAL · HYDRAULIC · AIR-OPERATED GEARS, 4 to 1000 H. P.

Specify

The

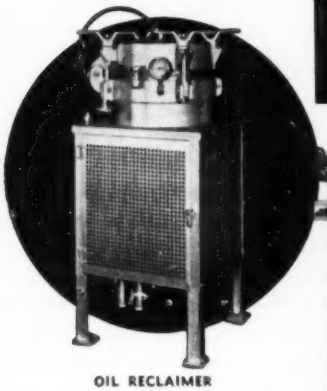
SNOW - NABSTEDT

GEAR CORPORATION

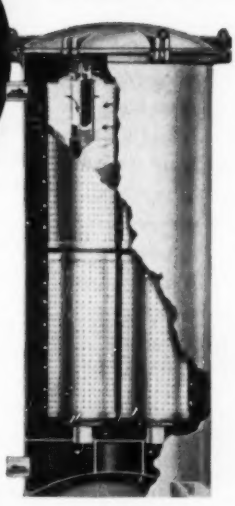
265 Welton St. Hamden, Conn.

Designed with features specifically for marine use.

HILCO LUBE and FUEL OIL PURIFICATION - - -



OIL RECLAIMER



FILTER

15 YEARS CONTINUOUS OPERATION WITHOUT OIL CHANGE IN DIESEL AND GAS ENGINES—NEGLIGIBLE PISTON AND CYLINDER WEAR.

THIS IS THE RESULT OF COMPLETE PURIFICATION—THE REMOVAL OF SLUDGE, CARBON, ACIDS, WATER, AND FUEL DILUTION.

HILCO UNITS IN OPERATION LONG ENOUGH TO PROVE THEIR VALUE. ONE-QUARTER CENTURY OF EXPERIENCE IS AT YOUR SERVICE.

- PURIFIERS
- FILTERS
- RECLAIMERS
- CONDITIONERS

THERE IS A HILCO FOR EVERY LUBRICATION AND FUEL OIL FILTERING PROBLEM - - -

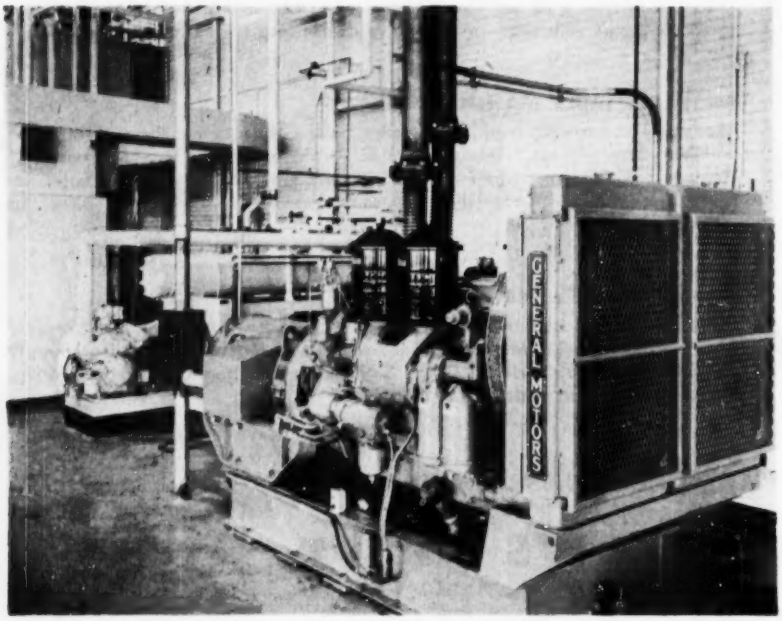
YOU WANT CLEAN OIL AND CLEAN ENGINES TO SAVE EQUIPMENT—OIL AND MONEY—INVESTIGATE HILCO OIL MAINTENANCE METHODS.

★ WRITE FOR FREE LITERATURE - - NO OBLIGATION

THE HILLIARD CORPORATION, 120 W. FOURTH STREET, ELMIRA, N. Y.

IN CANADA—UPTON-BRADEEN-JAMES, LTD., 990 BAY STREET, TORONTO, 3464 PARK AVE., MONTREAL

Field Notes



Standby Protects Blood Plasma Processing

Today, blood plasma is an essential item. A power interruption of only a few minute's duration could cause serious loss of materials and damage to equipment.

To insure the flow of plasma for the armed services and protect costly equipment, the Upjohn Company has installed a GM Twin Six diesel-electric generating set illustrated above.

Most vulnerable to possible power failure, are the condensing cabinets which dehydrate the plasma. When in use, they must be operated continuously for periods of 48 hr and kept at a temperature of 85°F below zero. Inside the cabinets, revolving scrapers are used to dislodge frozen moisture accumulated from the plasma.

If these scrapers are stopped for even a matter of minutes, they freeze to the sides of the unit and could be twisted entirely off their shafts when power is resumed. Damage to the equipment can only be avoided by thawing. However, this would risk the loss by contamination of a capacity load of plasma.

English Firm Introduces Light-Weight Diesel Bus

A major attraction at a transport exhibition in England recently, was a new underfloor, diesel-engined, 44 seater bus chassis by Leyland Motors, Ltd., which weighs only 3¾ ton and is primarily meant for urban service in that country. The bus body gives a complete vehicle weight below six ton. A 24-gal fuel tank is slung on the frame rear overhang on one side, making a full tank load more than adequate for a full day's operation because of low fuel consumption.

More New Diesels Installed On RRs This Year Than Last

Class I railroads put in service more new locomotives in the first nine months of 1952 than in the same period last year, it was announced, but the number of power units was slightly less. Most of the new locomotives installed both years were diesels.

The 1893 new locomotives of this period were made up of 2417 power units, while the 1856, last year, were made up of 2573 power units. Of the total number installed so far this year, 1879 were diesel and consisted of 2402 power units. In the first nine months of 1951 there were 1840 diesels put in service, consisting of 2555 power units.

Professor Finds "Memory Metal" But What's the Use?

Dr. Thomas A. Read, associate professor of Metallurgy at Columbia recently discovered "a metal with a memory" while testing the properties of various metal alloys.

An alloy of gold and cadmium the bar of metal can be bent easily when cold, but on being heated to about 150°F, it straightens up and resumes its original shape. Professor Read found that this change in shape is due to a shift of atoms in the crystalline structure of the alloy.

Just one question remains to be answered: what practical use can be made of this "memory metal"? He welcomes your suggestions.

Atomic Research Laboratory Established on Long Island

Walter Kidde Nuclear Laboratories, a privately-financed research organization devoted primarily to the development of atomic power for commercial and industrial purposes, has established new laboratory facilities on Long Island to serve as headquarters for the firm's operations.

The company was organized to carry out three fundamental objectives: to develop commercial atomic power, with emphasis on research and development in the field of low-cost nuclear reactors; to cooperate with government agencies in the development and design of atomic facilities; and to collaborate with private organizations interested in the application of the nuclear sciences to specific problems.

Test One-Rail Train in Germany

German and foreign scientists unveiled details recently on a mono-rail, super-speed train, claimed to be as fast as some airplanes and absolutely safe. The project is based on a plan of Swedish financier, Dr. Axel Wenner-Gren.

Construction of the one-mile, 80-yard steel and concrete test track began ten months ago. Sponsors say construction of the first mono-railroad will begin "somewhere in the world" within the next year, some sources saying the place will be British South Rhodesia.

Dr. Hinsken. German engineer, claims the first full-size train will reach a maximum speed of more than 185 mph. The model, made of light metal, consists of a coach and an engine which carries the power unit. It runs on ball bearings instead of on wheels, over a concrete track which has one continuing steel flange on top and two flanges on each side which the train grips from beneath. The foot-wide track is supported by pillars tilting up to 45 deg to conform with curves.

The train draws its power from two small electrical conducting rails at each side of the track.

Education-Industry Confab

The New Jersey State Department of Education and the Thomas Alva Edison Foundation, West Orange, New Jersey, have announced their joint sponsorship of the Fourth Edison Foundation Institute to be held November 24 and 25, 1952, at West Orange.

The joint Institute will explore ways and means for industry and education to work together to enable students to obtain an understanding of the role played by engineering and science in industry, and to encourage them to choose careers in those fields. Fifty industrialists, educators and civic leaders have been invited to attend.

Inadequate Storage Space Boosts Fuel Deliveries

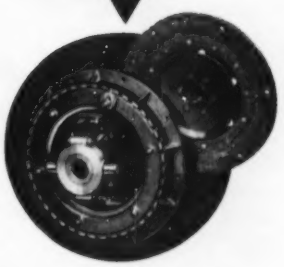
A drastic need for increased deliveries of oil to bulk plants has been created by inadequate storage facilities, F. S. Burroughs, distribution division secretary of the Oil-Heat Institute of America, declared in an address before the National Tank Truck Carriers Conference.

The annual business meeting of the Conference, held in conjunction with the American Trucking Associations' national convention, dealt mainly with problems facing tank truck operators, Burroughs giving the main address.

About 4,000 persons are dependent on each for fuel oil for their furnaces, the official stated. He called on the trucking industry to increase efficiency of its deliveries to offset storage shortages which he called "one of our industry's king-size migraines".

Describing the problem as acute despite an 86 per cent increase in facilities during the past five years, he suggested round-the-clock deliveries to key points as standard procedure, and pricing measures which would encourage consumers to fill tanks during summer months.

Geared To Move Big Loads



Built To Stand The Gaff

Every part of the rugged ALLIS-CHALMERS tractor has strength to move the largest load it's ever meant to move—and *more* — with a maximum margin of safety. Heavy duty ROCKFORD CLUTCHES help it deliver more efficient, more productive work cycles. Let ROCKFORD clutch engineers help *you* design dependable power transmission controls.

ROCKFORD CLUTCH DIVISION BORG-WARNER
1301 Eighteenth Avenue, Rockford, Illinois, U. S. A.

B-W
B-W ENGINEERING MAKES IT WORK
B-W PRODUCTION MAKES IT AVAILABLE!

ENGINEERING BULLETIN SENT ON REQUEST

ROCKFORD CLUTCHES

W. J. Connell Co. To Open New Plant in Newton, N. J.

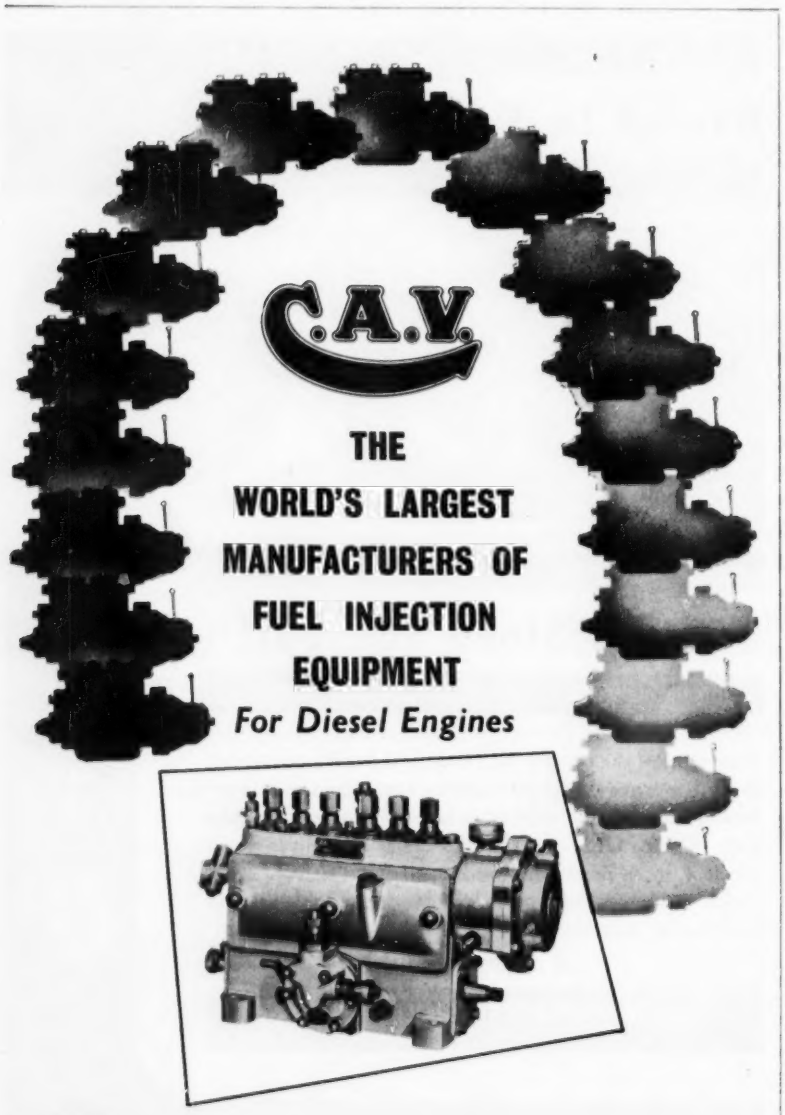
The W. J. Connell Co., New England automotive distributors, has recently broken ground for a new $300,000 office and warehouse building in Newton, N. J. Continued growth and recent acquisition of the William H. Flaherty Co. have made the expansion necessary. The Connell organization now serves 800 franchised wholesalers in the New England states. Construction is expected to proceed rapidly and occupancy is anticipated during February of 1953.

SAE Meeting Reviews Operations of Diesel Engine in Industry

Operation of diesel engines in industry, particularly for railroad and cargo-handling service, was reviewed at the Society of Automotive Engineers' National Diesel Engine Meeting held in St. Louis recently.

The meeting opened with a presentation of technical papers outlining progress in the use of the spectograph and electron microscope in studying diesel operating conditions with respect to satisfactory lubrication. One paper gave reports on spectroscopic analysis of engine oils for controlling maintenance operations made on 18 railroads. Another reported satisfactory use of electron microphotographic studies in revealing contaminants in diesel lubricants.

Other papers included engineering problems arising from the changeover of steam locomotives to diesel-electrics, the use of diesel engines in fork-lift trucks, and the development of a new-type diesel engine for Air Force use.



C.A.V.

Fuel Injection and Electrical Equipment

Depots and Service Agents in over 100 countries

C.A.V. DIVISION OF LUCAS ELECTRICAL SERVICES INC., 653, TENTH AVENUE, NEW YORK 19, N.Y.
Sales Office: 14820 DETROIT AVENUE, CLEVELAND 7, OHIO Ⓒ 174-479

U. S. Tariff Cut Pumps New Life Into Canadian Oil Boom

Recent 50 per cent reduction in the U.S. tariff on crude oil imports, was hailed by Canadian oilmen as a major development in the country's fast-growing oil industry.

For Canada, the chief results that can be expected from the most-favored-nations oil tariff cut from 21¢ to 10½¢ a bbl are: a considerably wider potential market for Canadian oil in parts of the U. S., particularly in Washington, Wisconsin, Minnesota, and California; potential Canadian exporters will start off with the same business chances as long-established exporters from other countries; possibility that U. S. refining interests will review and find attractive the economics of piping oil from Superior to Minneapolis-St. Paul, a potential market of 125,000 bbl a day.

Westinghouse Wins Army Contract For Gas Turbine Power Plant

The U. S. Army Corps of Engineers has awarded the Westinghouse Electric Corp. a contract in excess of $1 million for the construction of a railway-mounted gas turbine power plant. Intended to be used as an advance power generation unit in devastated areas, the plant will be contained in two non-self-propelled railway cars.

The generator car will contain a 5000-kw, 5700-rpm gas turbine designed to burn diesel oil; a geared

speed-reducer to drive the generator at 3600 rpm for 60 cycle power, or at 3000 rpm for 50 cycle power; a 2400-v AC generator; a generator exciter; and a starting motor for the gas turbine.

The other car, the transformer-control car, will house a multi-voltage transformer, with output ranging from 2400 v to 15,000 v; high and low voltage switchgear; and two diesel generators for auxiliary power, one of which will supply the starting motor.

The cars will be subcontracted to the Puget Sound Bridge and Dredging Co. of Seattle, where apparatus will be installed and tested.

Alco Holds Educators Meeting

The American Locomotive Co. played host to more than 40 faculty members of leading Northeast engineering colleges recently at an educators' meeting held in conjunction with the Diesel Engine Manufacturers Association.

Purpose of the special DEMA meeting was to acquaint university representatives with the engineering facilities, staff organization, and developmental projects of a modern diesel engine manufacturer. The visitors toured Alco's diesel engine and locomotive shops where they observed production techniques and equipment at first hand. Presentation of technical papers by Alco engineers was also included on the program.

AIEE Schedules Technical Conference at Philadelphia

Seventeen technical papers will be presented during an American Institute of Electrical Engineers Technical Conference on recording and controlling instruments in Philadelphia, November 17-18. Cooperating societies are the Instrument Society of Mechanical Engineers. Control instruments and industrial applications will be studied.

Student Design Award Program

The Heli-Coil Corp. of Danbury, Conn. announces the 1952 Heli-Coil

Consult ELLWOOD on all Your Forging Requirements

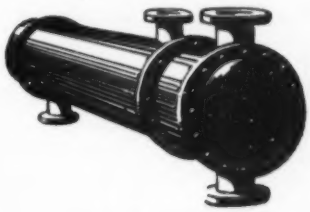
Quality Precision Crankshafts For Diesels — Since 1910 . . .

ELLWOOD CITY FORGE COMPANY

CRANKSHAFTS · CONNECTING RODS
MACHINE FORGINGS

ELLWOOD CITY, PENNA.

JACKET WATER and LUBE OIL COOLERS



Work Better When Oakite-Cleaned

IF you are getting poor performance from your Diesel heat exchange equipment—chances are that lime scale is closing the waterways and interfering with proper heat transfer.

One way to remove the scale is to rod out the tubes. That method, though, uses up a lot of valuable time and effort. There's always the chance, too, of costly tube damage.

The Easy Oakite Way!

A much simpler, quicker way (and definitely less expensive) is to dissolve the lime scale by circulating a solution of Oakite Compound No. 32 through entire system . . . jacket water coolers, lube oil coolers, etc.

Ask for Demonstration

Your local Oakite Technical Service Representative will be glad to demonstrate the widely-used Oakite method of removing lime scale and rust chemically. Call him today. Or write Oakite Products, Inc., 22C Rector Street, New York 6, New York. Ask for FREE booklet No. 4305. It gives a graphic description of how specialized Oakite Compound No. 32 gets rid of scale and rust quickly, safely, inexpensively. No obligation. Send today!

SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS · METHODS · SERVICE

Technical Service Representatives Located in Principal Cities of United States and Canada

Engineering Student Design Award Program, open to resident engineering undergraduate students in any school in the U. S. and Canada. Cash awards range from $100 to $1000 for the most original new uses for Heli-Coil thread inserts. The period of award is from October 1 to December 31, 1952. Students desiring to participate must apply to the company.

Diesels Are Most Economical In Fuel Costs for 1952

A survey of locomotive fuel costs for the first six months of 1952 shows diesel to be the most economical in all three services: freight, passenger, and yard switching. For given amounts of freight, passenger, and switching work, diesel fuel cost were: 44 per cent, 21 per cent, and 41 per cent lower, respectively, than the nearest rival power.

In addition, diesels handled about 11 per cent more freight work and seven per cent more passenger and yard work during the first seven months of this year than they did in 1951. Diesel percentages follow:

Gross Freight Ton-Miles

Power	7mo/1952	1951	1946
Diesel	64.20	52.66	9.73
Coal-burning steam	26.74	35.85	69.55
Oil-burning steam	7.14	9.65	18.60
Electric	1.85	1.83	2.11

Passenger Train-Car Miles

Power	7mo/1952	1951	1946
Diesel	70.03	62.73	15.28
Coal-burning steam	13.70	19.11	52.05
Oil-burning steam	9.62	11.78	26.19
Electric	6.65	6.38	6.48

Yard Switching Hours

Power	7mo/1952	1951	1946
Diesel	75.49	67.79	29.46
Coal-burning steam	19.17	25.80	59.60
Oil-burning steam	4.02	5.17	9.57
Electric	1.32	1.19	1.24

Westinghouse Engineer Awarded $3000 for Suggestion

Charles H. Parker, Westinghouse Electric Corp. engineer, who suggested an improved and highly significant method for manufacturing compressor and turbine rotors for jet engines, has been awarded a check for $3000 by the company.

"Mr. Parker's suggestion," the president of Westinghouse, Mr. Price, said, "to apply the mechanical principle of curvic coupling to the manufacture of jet engine compressor and turbine rotor assemblies, was a major factor contributing to the successful design and production of the new Westinghouse J40 engine."

The new method, already adopted by other jet engine manufacturers in this country and abroad, solves a knotty production problem which has plagued engineers.

Locomotives for Brazil Beat Delivery Schedule

The first two of 32 Baldwin-Westinghouse diesel-electric locomotives, ordered last winter by Central Railways of Brazil, have been delivered six months ahead of schedule, it was recently announced.

The shipment is part of the railroad's current program to extend die-

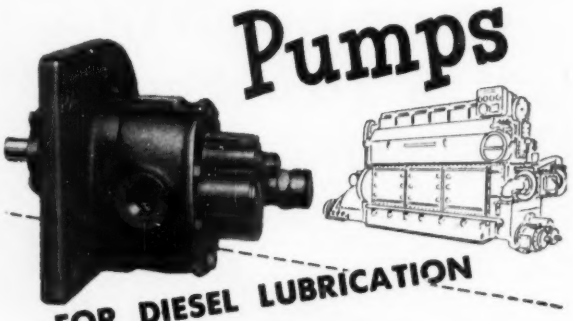
"AMOT" THERMOSTAT

"Performance without trouble" is the reason more engine manufacturers, pipe lines, power plants, oil companies and shipyards are using AMOT as standard for automatic engine water and oil temperature control. AMOT thermostats offer the following advantages:

1. Large capacity combined with light weight.
2. Excellent reliability even under extreme shocks and vibration.
3. No external bulbs or tubing to break and cause trouble.
4. Temperature is fixed and cannot be tampered with by operator.
5. Holds close regulation and is not sensitive to pressure.
6. Operating forces are very large and with no packing glands there is no chance of valve ever sticking or becoming inoperative.
7. Because of its simple and rugged construction, practically no maintenance is ever required.
8. Has positive 3-way valve action in which full pump capacity flows through the engine at all times.
9. Compact in size and will operate in any position, which facilitates piping.
10. Available in pipe sizes up to 6" for all types of gas and diesel engines.

Write for catalog and name of your nearest AMOT representative.

AMERICAN MOTORS CO., RICHMOND 5, CALIF.



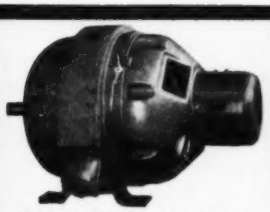
THE rotary geared pump shown above is particularly suited for diesel lubrication systems. It has a special flange mounting to facilitate installation together with provision for tachometer drive. Thousands of Brown & Sharpe Pumps are now providing trouble-free service for transfer, lubrication and booster systems. Get acquainted with their reliability and economy. Write for Catalog. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

We urge buying through the Distributor

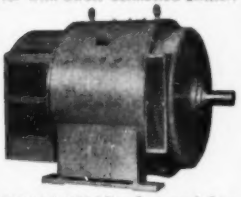
BROWN & SHARPE BS

Champion Performers

COLUMBIA



93.8 KVA, 900 RPM, A. C. Generator with Direct Connected Exciter.



200 KW, 900 RPM, Protected, Two Bearing D.C. Generator.

A. C. AND D. C. GENERATORS. For the greatest exhibition of quality and service use performance proved Columbia A.C. and D.C. Generators. Available for coupled service, belt drive, single or two bearing.

A. C. Generators: 6¼ to 1000 KVA
D. C. Generators and Exciters: 2 to 300 KW

Write for descriptive literature. Our engineers will be glad to review your requirements.

Protected Territories Available to Qualified Sales Engineers.

COLUMBIA ELECTRIC MFG. CO.
4537 HAMILTON AVE. · CLEVELAND 14, OHIO

KIENE®

MODEL K-120 UNIVERSAL PEAK PRESSURE INDICATOR

For Testing Firing and Compression Pressures on all Models of Diesel and Gas Engines. Dependable — Rugged. May be Used With or Without Flexible Tube.

MODEL K-120 Indicator has but one moving part — nothing to wear or get out of adjustment.

VALVE — Gas trap type with diaphragm type check valve having adjustable lift. Stainless steel valve and seat.

No springs — No pistons — no complicated adjustments — No temperature corrections — no pressure loss in check valve.

GAGE READS TRUE PRESSURE — MAY BE RECALIBRATED ON ANY GAGE TESTER

Check readings can be made over and over again by releasing indicated pressures with bleeder valve.

ADAPTORS available for most models of engines manufactured in U. S. A. Other models made to order at reasonable prices.

KIENE DIESEL ACCESSORIES, INC.
10352 PACIFIC AVE., FRANKLIN PARK, ILLINOIS

sel-electric operations to key sections of its lines, providing service between Rio de Janeiro and Belo Horizonte and the surrounding area. Replacement of the present steam locomotives is expected to reduce operating costs even though fuel must be imported.

The railroad is to receive twelve, 170-ton units that will operate on broad gauge (63-in) track, and twenty, 118-ton units for meter gauge (39-in) track. Delivery is scheduled for completion by the first quarter of 1953.

College Scholarship Contest For Sons of Railway Employees

The Frank Thomson Scholarship, established in memory of a former president of the Pennsylvania Railroad, for the benefit of sons of living or deceased employees of the railroad, will be filled by competitive examination, it was announced.

Beginning with the 1953-54 year, winner of the scholarship will be entitled to a four-year technical education at any school of his choice. Tests are to be held on December 6, 1952, January 10 and March 14, 1953, under the supervision of the College Entrance Examination Board of Princeton, N. J. and Los Angeles, Cal.

Giant Conveyor System Speeds Ore from Ship to Shore

Ore unloading facilities of the Canton Railroad in the Baltimore harbor have been expanded to speed up transfer of incoming ore from ships to railroad cars.

The plant has a maximum rated capacity of 3000 ton an hour, about double the previous tonnage. It is equipped with a giant conveyor system which speeds the process at the rate of 50 cars an hour.

The expansion program anticipates increased imports of ore from new developments in Labrador, Venezuela, Brazil, and Liberia as well as larger imports from older producing sources. Ore imports are increasing due to depletion of reserves in the United States.

Before the modernization program was undertaken, two cranes on the pier scooped the ore out of the ships and discharged it directly into the railroad cars. With the new conveyor system, the Canton facility becomes the only one on the East Coast to have both a crane system to unload directly to cars and a conveyor system which passes through a weighing station to cars. The railroad is also building a 500-car supporting yard for the pier.

Organizational News

Director for Diesel Power, Inc.

R. A. Wells, chief fuels and lubricants engineer in the aviation section of Gulf Oil Corp., has been elected a director of Diesel Power, Inc., manufacturer of air-cooled diesel engines. It is believed that his election to the board will strengthen the position of the company in the aviation industry.

Before joining Gulf, Mr. Wells was associated with the Wright Aeronautical Corp.

GM Appoints Works Manager

Appointment of John W. Brophy as works manager of the Cleveland Diesel Engine Div. of General Motors Corp. has been announced. He has been serving as acting general manager of Diesel, Ltd., London, Ont., since October 1951.

Mr. Brophy has been with the company since 1919. Prior to his previous appointment, he had been director of purchasing and production control.

Purolator Promotions

James V. Blusewicz and Stanley G. Hegeman were named assistant factory managers of Purolator Products, Inc. for the main Rahway, N. J. plant. Both men came up through the ranks.

Mr. Hegeman has been with the company since 1925. He initiated operations at both the old Newark plant and the Rahway plant, and recently managed the new Ringtown, Pa. factory.

Mr. Blusewicz joined the company in 1930 and rejoined again during World War II as foreman. In 1945, he was appointed plant superintendent.

Harry T. Kessler

Tuthill Pump Elects President

Harry T. Kessler has been appointed president and treasurer of the Tuthill Pump Co., Chicago, after serving as executive vice president since 1943. In his new position, he will direct an expansion program to introduce new products in the company's line.

New Sales VP for Pierce

Lionel B. Hakes has recently been appointed vice president in charge of sales for the Pierce Governor Co., Inc. Previous to his entrance to the company, Mr. Hakes had been associated with Nash Kelvinator Corp. for 10 years.

Permutit Promotes Engineer

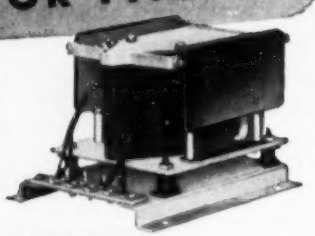
The Permutit Co. announces the appointment of Felix W. Saco to the position of mechanical development engineer, assigned to work on the design of all applications of ion exchange materials and techniques in the treatment of water and other liquids.

Mr. Saco has been granted several patents for the application of a waste water boiler for internal combustion engines. His past contributions to industry include development of a self descaling sea water still; design work on nuclear reactor; and design of a control valve for aircraft cabin pressurizing and cooling.

Burlington

GENERATOR VOLTAGE REGULATOR TYPE WA

FORMERLY WARD-LEONARD Type 5660



Designed for use in regulating the voltage of A.C. generators in Stationary, Mobile or Marine installations. Direct rheostatic action provides a simple, effective and automatic means of regulating voltage by performing the function of an automatic field rheostat.

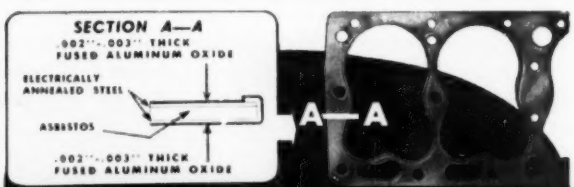
Rating of rheostatic element is 2 amperes maximum exciter shunt field current at full load and power factor. Maximum sigma watts is 50 watts.

FEATURES

★ DIRECT ACTING
★ FAST RESPONSE
★ AUTOMATIC CONTROL
★ SMALL, COMPACT SELF CONTAINED
★ RUGGED CONSTRUCTION
★ RHEOSTATIC ACTION
★ INEXPENSIVE

Inquiries for complete information and engineering services solicited.

BURLINGTON INSTRUMENT COMPANY
DEPT. B-112
BURLINGTON, IOWA



FOR A LASTING, PERFECT SEAL IN HIGH COMPRESSION ENGINES *Use Only*

Fitzgerald Metallic Aluminum-Fused-Oxide Steel Asbestos Gaskets

Grease Retainers — Cork Gaskets

FITZ-Rite Treated Fiber Gaskets for oil, gasoline and water connections. Complete Sets For Motor Rebuilders.

FITZGERALD Gaskets

SINCE 1906

The Fitzgerald Manufacturing Company

TORRINGTON, CONNECTICUT

There's a Fitzgerald Gasket for every Engine

"FIXED-READING"

PREMAX

PRESSURE INDICATOR

for DIRECT-READING of COMPRESSION AND FIRING PRESSURES OF EVERY TYPE OF DIESEL ENGINE

ONE OF THE FEATURES Responsible for Its Overwhelming Preference by Leading Diesel Manufacturers and Operators

No mistake can be made in reading—since only one figure appears in the window of the counter—and this figure represents the actual engine pressure directly in pounds per square inch.

For other features, write for Bulletin 294

--- ACCURATE PRESSURE READINGS as high as 1700 P.S.I.

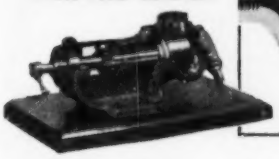
BACHARACH

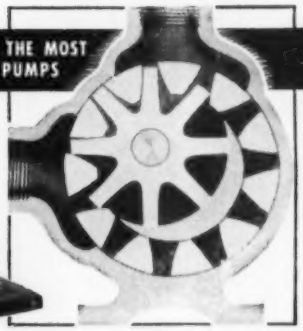
INDUSTRIAL INSTRUMENT CO.

7000 BENNETT STREET • PITTSBURGH 8, PA.

WHAT IT TAKES TO BUILD THE MOST COPIED OF ALL ROTARY PUMPS

EXPERIENCE and ENGINEERING SKILL of the VIKING PUMP COMPANY





Slide rule, graph and drawing paper are basic in developing rotary pump ideas.

The answer to Viking leadership, however, is beyond these basic materials.

Viking's store house of ideas holds thousands of feet of micro-filmed installation facts and drawings. Their use, plus continual experimenting and testing of new ideas produces results that make Viking the most copied of all rotary pumps.

Send for descriptive folder 52SD today.

See Our Catalog in SWEETS

Viking PUMP COMPANY

Cedar Falls, Iowa

Edwin A. Desmond

Ethyl Names New Diesel Head

Edwin A. Desmond has been named head of a new diesel section in the technical service division of Ethyl Corp. In his new assignment, Mr. Desmond will assume responsibility for all field tests of diesel fuels and diesel fuel additives.

Mr. Desmond joined the company as a student engineer in 1939 and entered the Navy in 1943. Rejoining the company in 1946, he was assigned to the aeronautical research division and served as liaison engineer with the air lines and the armed services from 1949 to 1952.

Union Carbide Chairman Dies

Fred H. Haggerson, chairman of the board of Union Carbide and Carbon Corp., passed away recently after a short illness. He was 68 years old.

Mr. Haggerson, who had been with the company for over 33 years, became chairman of the board in 1951. He had been made vice president in 1938, a director in 1941, and president and member of the executive committee in 1944.

Scaife Assigns New VP

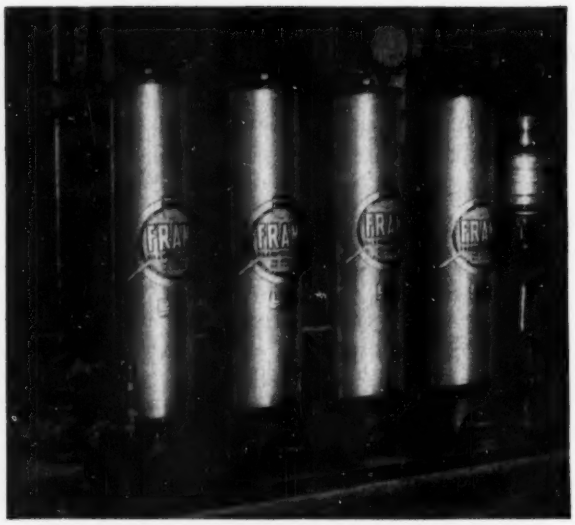
Sheller L. Steinwender has been appointed vice president in charge of sales by the Scaife Co. He has previously been associated with A. O. Smith Corp. as general sales manager. Prior to that he was connected with American Cyanamid Co.

Bosch Appoints Veep

Donald H. Spicer has been made vice president, manufacturers sales, of the American Bosch Corp. He will be responsible for sales of component parts of engine-powered equipment.

Mr. Spicer comes to the company from the Firestone Tire & Rubber Co., where he had served as president of their World Bestos Corp. Div. from 1941. He is a mechanical engineer and a member of the Society of Automotive Engineers.

Donald H. Spicer



This unit of four Fram Filters serves two 500 hp air injection Fulton Diesels in large eastern quarry. Another unit of three Fram Filters protects 1000 hp solid injection Fulton Diesel from harmful quarry grit and dust.

FRAM FILTERS Protect Vital Diesel Engines from Quarry Contaminants

Two Fram Filter installations protect a large Eastern quarry's vital diesels from damage by engine-killing sand, lime and cement. These diesels drive generators that supply the entire plant with power . . . must operate 24 hours a day, 6 days a week to maintain production.

The quarry's chief engineer is plenty enthusiastic about time- and money-saving Fram Filters —says all his diesels must be Fram-equipped for maximum service.

Let FRAM Solve YOUR Diesel Filtering Problems

Fram Filters can:

- protect your diesels
- reduce costly down-time
- prolong engine life
- lower operating costs

Write today to: **FRAM CORPORATION, Providence 16, R.I.**

In Canada: **J. C. Adams Co., Ltd., Toronto, Ontario**

FRAM

OIL • AIR • FUEL • WATER

FILTERS

"WHY HAVEN'T I HEARD OF THIS BEFORE?"

This is what friends of DIESEL POWER readers are saying the first time they see a copy. Here is what one of our readers report.

"Have been inquiring throughout the diesel plant where I work and have found much interest in the old issues which I have circulated there. Many had no idea that such a magazine existed and are very interested in obtaining subscriptions for themselves."

New men are entering the diesel field every day—your friends and associates. You can help them in their work and help yourself at the same time . . .

you can win a **FREE** copy of one of these VALUABLE REFERENCE VOLUMES.

*****

For every 2 new subscriptions to DIESEL POWER, we will award a copy of the New "FUEL INJECTION SYSTEMS", which sells for $1.50.

For every 5 new subscriptions to DIESEL POWER, we will award a copy of the "DIESEL ENGINEERING HANDBOOK", Deluxe Edition. This volume covers the entire field of land and marine diesels . . . and sells for $7.50.

*****

Address all subscription orders, correspondence and questions on the above to:

CIRCULATION MANAGER

DIESEL PUBLICATIONS

192 Lexington Avenue, New York 16, N. Y.

What Do You Know!

(*Answers to question on Page* 45)

1. Correct answer is "a". The ability of dual-fuel engines to burn this by-product of sewage treatment makes them a logical form of power for these plants. For details see the article on Page 40.

2. "C" is correct. While this is the purpose, it will result in "a" and also, in some degree, in "b". The fact that exhaust temperatures are fairly constant with varying load when the optimum air/fuel ratio is maintained, permits thermal control of air supply. See article mentioned above.

3. Correct answer is "b". Such bearings are being successfully used in the Baldwin railroad engine. This and other details are discussed in the article on Page 46.

4. "A" is correct. Maximum pressures and temperatures are encountered at this point. Apparently, reversal of direction with disturbance of oil films, is also a factor since the second greatest point of wear is usually at the lower end of ring travel. See also article mentioned above.

5. Correct answer is "c". It is considered bad practice for the welfare of the entire battery to impose additional current drains on only part of the entire unit. For more on this and other means of safeguarding batteries, see article on Page 63.

6. Correct answer is "b". Detonation is the auto-ignition of the end-gas trapped in a cylinder under certain conditions. Rough combustion is the result of an extremely rapid rate of pressure rise in the cylinder. For a discussion on combustion phenomena, see the article on Page 54.

7. Correct answers are "b" and "c". Answer "b" however, is the most practical from the operator's viewpoint and involves only commonly available equipment. For full discussion, see the article mentioned above.

E. D. Tull

New Cummins General Manager

E. D. Tull has been named to the newly created position of vice president and general manager of Cummins Engine Co., Inc.

Mr. Tull has been with the company since 1928. In February of this year, he was named vice president of personnel and plant and recently was elected to the board of directors. As vice president and general manager, he will be responsible for coordinating the work of the five divisions of the company.

SEND US YOUR OLD INJECTORS

(From G. M. C. Model 71 Diesels)

And Save A Large Percentage of Your ReBuilding Costs

YOUR ADVANTAGES

* Each Injector Completely and Carefully ReBuilt to Factory Specifications.
* All Necessary Parts Replaced at no extra charge. *This includes the Plunger and Bushing Assembly when necessary.* (Plunger and Bushing Assembly alone Lists at $18.53!)
* Each Injector is Rebuilt with New and Genuine Crown Valves, Valve Springs, Filters, Etc.
* Conversions from one Output to Another Output at no extra charge. You can send in used #60s in Exchange for ReBuilt #70s, #80s, etc., at *No Extra Charge.*

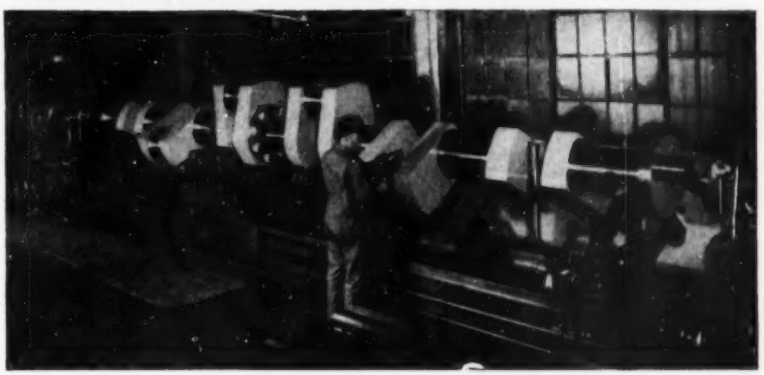
Injector Exchange, each **$12.50**

OUR WARRANTY: Each and every one of our ReBuilt Units is assembled and tested in strict accordance with manufacturer's specifications. Should any of our units fail to satisfy YOU we will make immediate replacement without charge!

AMERICAN DIESEL SERVICE

3493 West 140th Street Cleveland 11, Ohio

DIESEL CRANKSHAFT REPAIRING AND REFINISHING



Picture shows a thirty-foot crankshaft with 14" diameter journals which was broken through the No. 6 web— receiving final inspection after new crank and center coupling sections were installed and machined to original tolerances.

Shafts of all sizes and types successfully repaired and refinished.

Call, wire or write for particulars on our field repairs and emergency service.

WASHINGTON IRON WORKS, INC.

Established 1876

SHERMAN, TEXAS

Roosa-Master

(*Continued from page 39*)

down and before the governor can act, conditions remain constant except that the rpm are reduced. This allows slightly more "time" (although the same angular travel) for the fuel flow and, consequently, slightly more fuel is delivered to the cylinder. The result is partial compensation before the governor has a chance to act. The effect is reversed if the engine should speed up through loss of load.

Summing Up

Here, we have a fuel injection pump that has gone through extensive development and apprenticeship in the field. It is currently under test by several engine builders and has been accepted by one of the larger producers of engines for both domestic use and export.

Functionally, it has demonstrated its ability to meet the requirements of today's rigorous service. It flexibility of mounting (it will operate in any position), its compactness and its low weight are not only desirable features for existing engines but have opened new design possibilities in the diesel and other fields.

Most of the manufacturing items that represent high costs have been either engineered out of the unit or have been reduced to a minimum. This will be particularly important when a high volume of production is reached as it will have an important effect on costs.

The few moving parts, provisions for ample lubrication and elimination of dirt entry, lack of highly loaded surfaces, absence of poppet valves, complicated springs, etc., promise a long-life-expectancy. This has been borne out in all field testing to date.

An additional feature that has been developed and is being used on high speed automotive diesels operating at speeds in excess of 3000 rpm is an automatic timing advance.

This is accomplished by the moving of the normally stationary cam with a hydraulic servo-motor receiving its power from the vane type transfer pump. It can readily be seen that the transfer pump pressure can be made to rise with engine speed and in doing so advance the cam along a predetermined timing curve.

This pump has been tested at continuous speeds in excess of 4000 engine rpm.

Current plans call for a policy of low service cost on a factory exchange basis. There is only one adjustment and that is made at the factory. The rotor, cam ring and hydraulic head are the only parts that might normally require replacement and all the necessary work for their replacement can be performed with standard, normally-available tools. Calibration is not required.

These units are now beginning to go into service. And there is every reason to think that they will constitute an important contribution to the high-speed, small engine diesel field.

For FUEL TRANSFER and
HYDRAULIC GOVERNOR
SERVICE
You Can Depend
on TUTHILL
Model L Pumps
Here is the pump that's known throughout the diesel industry for its dependable performance in fuel transfer and hydraulic governor service. Tuthill Model L is a positive displacement, internal gear rotary pump, mechanically sealed for quiet, leak-free operation and low power consumption. Capacities from .33 to 3 g.p.m. in wide pressure ranges. Available as either single or double-pump units. Write for Tuthill Model L Bulletin.
25th
Anniversary
TUTHILL PUMP COMPANY
939 E. 95th Street, Chicago 19, Illinois

STATEMENT OF THE OWNERSHIP, MANAGEMENT AND CIRCULATION REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946 (Title 39, United States Code, Section 233)

State of New York }
County of New York } ss.

Of DIESEL POWER & DIESEL TRANSPORTATION published monthly at Orange, Connecticut, for October 15, 1952.

1. The names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Diesel Publications, Inc., 192 Lexington Ave., New York 16, N. Y. Editor, Brian P. Emerson, 192 Lexington Ave., New York 16, N. Y. Managing editor, None. Business manager, A. N. Goding, 192 Lexington Ave., New York 16, N. Y.

2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given.)

Diesel Publications, Inc., 192 Lexington Ave., New York 16, N. Y.; Jessie W. Rosencrans, Mamaroneck, New York; Dorothy R. Brighton, Mamaroneck, New York; George R. Brighton, Mamaroneck, N. Y.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state).

None.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bonafide owner.

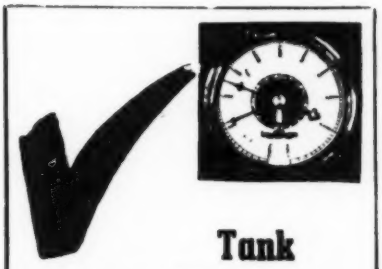
5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required from daily, weekly, semiweekly, and triweekly newspapers only.)

DIESEL PUBLICATIONS, INC.
GEORGE R. BRIGHTON, Pres.

(Signature of editor, publisher, business manager, or owner)

Sworn to and subscribed before me this 2nd day of October, 1952.

MURRAY MARSH, Notary Public
State of New York No. 41-7230300
Qualified in Queens County
Certificates filed with Queens, N. Y., Bronx
Kings and Nassau County Clerks
Certificates filed with Queens, N. Y., Bronx
and Kings Registers
(SEAL) Term Expires March 30, 1954



Tank Contents At A Glance

With Liquidometer remote reading fuel storage tank gauges you can check quickly and accurately oil deliveries, consumption and amount on hand. No Diesel plant is complete without one. Liquidometer or Levelometer models are available for tanks of any capacity.

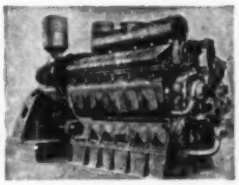
Write for complete information

THE LIQUIDOMETER CORP.

36-24 Skillman Ave., Long Island City, N. Y.

DIESEL ELECTRIC POWER

for IMMEDIATE SHIPMENT
Unit Capacities
100 to 1875 Kva A.C.
50-60 Cycles
Various Voltages



Write or wire today for bulletins and complete information regarding these fine fully guaranteed, low cost DIESEL ENGINE GENERATING UNITS. Visit our plants at Sausalito (S. F.), California, and Jersey City, N. J., and see units in operation on our test stand.

"SPECIALISTS IN DIESEL POWER"

A. G. Schoonmaker Co., Inc.

56 Church St., New York 7, N. Y.

WANTED G. M. "71"

Discarded injector parts & assemblies. 10 to 1000

interstate diesel service, incorporated
7120 CARNIGIE AVE. • CLEVELAND 3, OHIO

They're Ready Now To Fill Your Needs For

Trained DIESEL MEN!

and repair of all types of Diesel engines. The Diesel man you want is ready to go to work for you in the U.S. or Canada, or will travel farther if the opportunity is right. Tell us your needs. UEI graduates are energetic, willing workers. They have good basic training in operation, maintenance

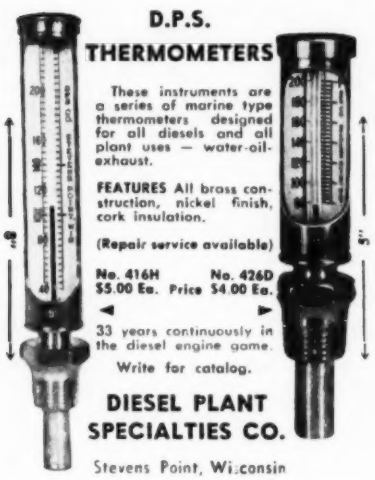
WRITE TODAY

UTILITIES ENGINEERING INSTITUTE

DIESEL DIVISION

"Training Men for Industry Since 1927"

2523 Sheffield Ave.
Chicago 14, Ill.



D.P.S. THERMOMETERS

These instruments are a series of marine type thermometers designed for all diesels and all plant uses — water-oil-exhaust.

FEATURES All brass construction, nickel finish, cork insulation.

(Repair service available)

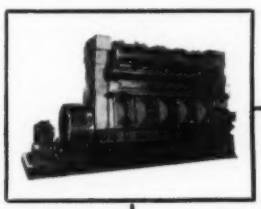
No. 416H $5.00 Ea. Price No. 426D $4.00 Ea.

33 years continuously in the diesel engine game.

Write for catalog.

DIESEL PLANT SPECIALTIES CO.

Stevens Point, Wisconsin



FOR SALE

Superior Heavy Duty Diesel Engine

510 H. P. at 360 R. P. M., 5 cylinders, 4 cycles, 14½ x 18, type ZDSB. Non-reversing, vertical, with cold starting and mechanical injection. Engine totally enclosed. For dredge pump service and general pumping duties.

The Boston Metals Co.

313 E. Baltimore Street
Baltimore 2, Md. — CUrtis 5050

WANTED

Experienced Diesel Engine Representatives

We would like to hear from several seasoned Diesel engine salesmen who have well rounded experience on engine applications in various markets. Send us a recent photograph and a detailed summary of your personal and business history with your letter. Replies will be held confidential.

Sales Development Division

Caterpillar, Peoria, Ill.

MEN TRAINED

IN PROTECTIVE MAINTENANCE AND GENERAL OVERHAUL

Diesel Engines, Tractors and Heavy Equipment

We specialize in the practical phase of training. Shop Method Home study. If you are employed in this field and need better "Know How", or if you are an Employer and need trained Men, Write Today! INTERSTATE TRAINING SERVICE, Dept. 28-M, 4035 N.E. Sandy Blvd., Portland 13, Ore.

BONUS

Send to DIESEL POWER the name of a friend who wishes to subscribe, and you'll receive—free—a copy of our famous 132 page Vest Pocket Diesel Manual—yours just as soon as his subscription fee is received.

FOR SALE DIESEL ENGINES

1—McIntosh-Seymour Model 4-B-33, 400 HP @ 200 RPM, Ser. No. 1834.

2—McIntosh Seymour Model 4-B-34, 400 HP @ 200 RPM, Ser. No. 1915 and 1918.

Engines will be in operation at Cromwell, Oklahoma until Dec. 15, 1952 and available for removal shortly thereafter.

INTERSTATE OIL PIPE LINE COMPANY

P.O. Box 1349, Tulsa, Okla.
Attn: Mr. J. M. Bradley,
Phone 5-5581, Write or Wire

ADVERTISERS' INDEX

Aerofin Corp. ... ***
Aeroquip Corp. ... ***
Air Maze Corp. ... ***
Aljon Electric Diesel Co. ... ***
American Air Filter Co., Inc. ... ***
American Bosch Corp. ... 15
American Brass Co. ... 28
American Diesel Service ... 87
American Locomotive Co. ... ***
American Motors Co. ... 82
Ashland Oil & Refining Co. ... ***
Atlantic Metal Hose Co. ... ***
Automotive Products Inc. ... ***

Bacharach Industrial Instrument Co., Inc. ... 85
Baldwin-Lima-Hamilton Corp. ... 8-9
Bendix Aviation Corp. Scintilla Magneto Div. ... ***
Binks Mfg. Co. ... ***
Borg-Warner Corp., Rockford Clutch Div. ... 79
Boston Metals Co. ... 89
Bowser, Inc. (Petroleum Marketing Div.) ... ***
Briggs Filtration Co., The ... ***
Brodie System ... ***
Brown & Sharpe Mfg. Co. ... 82
Brush ABOE, Inc., Petter Engine Div. ... ***
Burgess-Manning Co. ... ***
Burlington Instrument Co. ... 84

C. A. V., Ltd. ... 80
Caterpillar Tractor Co. ... 89
Chicago Pneumatic Tool Co. ... ***
Cities Service Oil Co. ... 10
Cleveland Graphite Bronze Co. ... ***
Columbia Electric Mfg. Co. ... 83
Cook Mfg. Co., C. Lee ... 30
Cooper-Bessemer Corp., The ... 4
Cummins Engine Co. ... ***
Cuno Engineering Corp. ... ***

De Laval Separator Co. ... ***
Delco Products Div., General Motors Corp. ... ***
Delco-Remy Div., Gen. Motors Corp. ... 16
Detroit Diesel Engine Division, Gen. Motors ... ***
Diesel Injection—Sales & Service ... ***
Diesel Plant Specialties Co. ... 89
Donaldson Co., Inc. ... ***

Eaton Manufacturing Co. ... ***
Electric Auto-Lite Co., The ... ***
Electric Storage Battery Co., The ... 6
Electro-Motive Div., Gen. Motors Corp. ... ***
Electro Products Laboratories ... ***
Elliott Co. ... ***
Ellwood City Forge Co. ... 81
Enterprise Engine & Machinery Co. ... 23

Fairbanks-Morse & Co. ... 13
Federal-Mogul Corp. ... 22
Fitzgerald Mfg. Co. ... 84
Flori Pipe Co., The ... ***
Fram Corp. ... 86
Fulton Sylphon Div., Robertshaw-Fulton Controls Co. ... ***

General Motors Corp., Delco Products Div. ... ***
General Motors Corp., Delco-Remy Div. ... ***
General Motors Corp., Detroit Diesel Engine Div. ... ***
General Motors Corp., Electro-Motive Div. ... ***
General Motors, Harrison Radiator Div. ... 18
Golten Machine Corp., Sigurd ... ***
Gulf Refining Co. ... ***

Harnischfeger Corp., P & H Diesel Div. ... ***
Harrison Radiator Div., Gen. Motors Corp. ... 18
Hercules Motors Corp. ... ***
Hill Diesel Engine Co. ... ***
Hilliard Corporation, The ... 77
Honan-Crane Corp. ... ***
Hunt-Spiller Corp. ... 24

Ideal Electric & Manufacturing Co., Inc. ... ***
Illinois Testing Laboratories, Inc. ... ***
Indianapolis Drop Forging Co. ... ***
Ingersoll-Rand Co. ... ***
Interstate Diesel Service, Inc. ... 89
Interstate Oil Pipe Line Company ... 89
Interstate Training Service ... 89

Johnson Bronze Co. ... ***

Kelite Products, Inc. ... ***
Kent-Moore Organization, Inc. ... ***
Kiene Diesel Accessories, Inc. ... 83
Kittell Muffler & Engineering, Inc. ... 83
Koppers Co., Inc., American Hammered Piston Rings Dept. ... ***
Krutilek George A. ... ***

Lanova Corporation ... ***
Leece-Neville ... ***
Lempco Products, Inc. ... ***
Lewis Co., Warner ... ***
Link-Belt Co. ... 32
Liquidometer Corp., The ... 89
Luria Engineering Corp. ... ***

Madison-Kipp Corporation ... ***
Manzel ... 76
Maxim Silencer Co., The ... 71
Merlin Engineering Co., Ltd. ... ***
Mid-Continent Petroleum Corp. ... ***
Missouri Portland Cement Co. ... ***
Mutual Chemical Co. of America ... ***

National Carbon Co. ... ***
National Welding & Grinding Co. ... ***
Nife, Inc. ... ***
Nordberg Mfg. Co. ... ***
Nugent & Co., Wm. W. ... 75

Oakite Products, Inc. ... 81
Ohio Crankshaft Co., The ... ***

Penn Controls, Inc. ... 69
Penn Flexible Metallic Tubing Co. ... ***
Peterson Welding Labs., Inc. ... ***
Petter Engine Div., Brush ABOE, Inc. ... ***
Phillips Petroleum Co. ... ***
Pickering Governor Co., The ... 7
Powers Regulator Co. ... 19
Pritchard & Co., J. F. ... ***
Pure Oil Co., The ... 14
Purolator Products, Inc. ... 26

Quincy Compressor Co. ... ***

Read Standard Corp. ... 70
Reiner & Co., John ... ***
Rochester Mfg. Co. ... ***
Rockford Clutch Div., Borg-Warner Corp. ... 79
Roper Corp., George D. ... ***

Schoonmaker, A. G., Inc. ... 89
Scintilla Magneto Div., Bendix Aviation Corp. ... ***
Sealed Power Corp. ... 17
Sharples Corp., The ... 12
Sims Co., The ... ***
Sinclair Refining Co. ... 20
Smith, E. R. ... ***
Snap-On Tools Corp. ... 73
Snow-Nabstedt Gear Corp. ... 77
Standard Oil Co., Inc. (California) ... 34
Standard Oil Co., Inc. (Indiana) ... Fourth Cover
Sterling Engine Co. ... ***
Struthers Wells Corp. ... ***
Surrette Storage Battery Co., Inc. ... ***
Synchro-Start Products ... 11

Texas Company, The ... 2nd Cover & 3
Thomas, C. H. ... ***
Thomas Flexible Coupling Co. ... ***
Tickle Engineering Works, Arthur ... 21
Tide Water Associated Oil Co. ... 29
Trane Co., The ... ***
Tuthill Pump Co. ... 88

U. S. Hoffman Machinery Corp. ... 74
Utilities Engineering Institute ... 89

Van Der Horst Corp. ... ***
Van Norman Co. ... 5
Viking Pump Co. ... 85
Vogt Machine Co., Henry ... ***

Washington Iron Works, Inc. ... 87
Waukesha Motor Co. ... 67
Weston Electrical Instrument Corp. ... 72
White-Roth Machine Corp. ... ***
Wildermuth, Inc., E. A. ... ***
Winslow Engineering Co. ... ***
Woodward Governor Co. ... 25
Worthington Corporation ... 27

Young Radiator Co. ... ***

Never any leakage—in or out—with Sylphon Packless Valves

● You can make important savings of gases or liquids the very instant you install Sylphon Packless Valves. For these dependable Valves stop tiniest leaks that might seep past the stuffing box of even the best packed type valve. They prevent waste—provide vacuum protection.

Sylphon Packless Valves have no packing. A rugged, dual-ply seamless metal Sylphon Bellows replaces the customary stuffing box. It provides a sure seal that permanently licks the leakage problem. The bellows seals the valve stem against corrosive, dangerous or inflammable liquids or gases. Extra protection against fire, explosion or other damage!

Wide range of sizes, types and materials—some for pressures up to 500 lbs. and temperatures up to 1000°F. Used on pipelines carrying oil, gasoline or other volatile liquids or vapors—in chemical plants, oil refineries, power plants, aboard ships. For complete information, write for Bulletin VD-813.

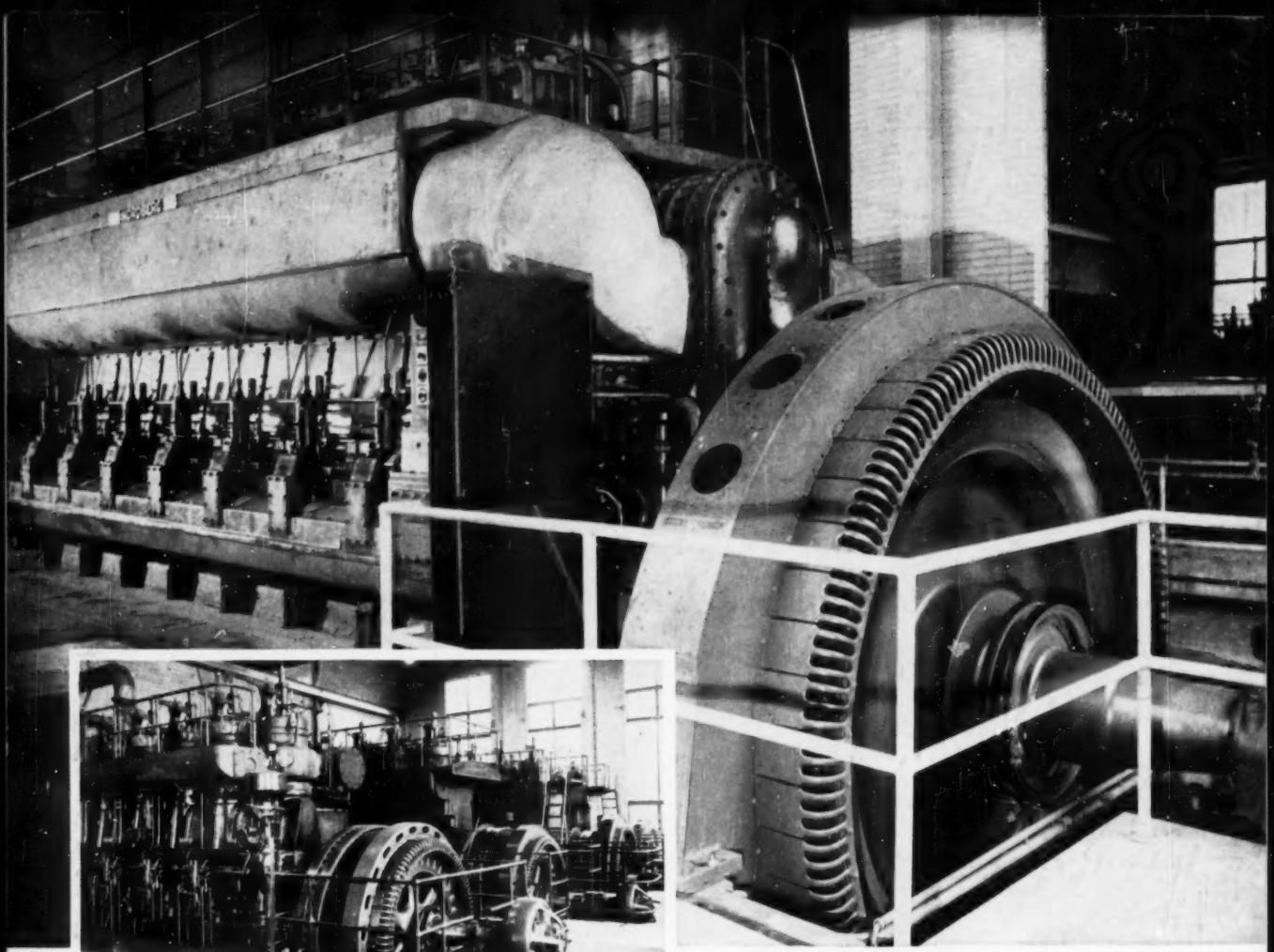
FIRST WITH BELLOWS

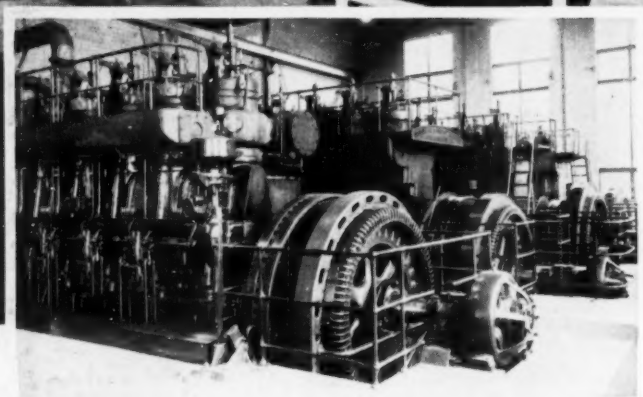
Temperature Controls • Bellows Devices • Bellows Assemblies

FULTON SYLPHON
DIVISION

ROBERTSHAW-FULTON CONTROLS CO., KNOXVILLE 4, TENN.

Canadian Representatives, Darling Brothers, Montreal





Rensselaer, Indiana, plant gets record economy with...

● Shown above are the five diesel engines, totaling 7,150 hp., which make the Rensselaer municipal plant one of the largest of its kind in Indiana. The efficient operation of these diesels has helped keep Rensselaer's lighting rates among the lowest in the state for cities in the 2,500 to 10,000 population group.

Contributing to this successful record, Standard Oil's diesel fuel and lubricants have helped keep operating and maintenance costs low. STANDARD HD Oil has played a particularly important role. This outstanding heavy-duty lubricant has provided effective lubrication of vital cylinder areas. It has kept cylinders and rings protected against excessive wear and free from deposits. How these benefits contribute to high operating efficiency is shown by the performance of the plant's newest and largest diesel, a 2,800-hp unit. In a typical month, this unit has operated for 444 hours, carried an average load of 54%, and generated 13 kw-hr per gallon of fuel with a lubricant consumption rate of 9,414 hp-hr per gallon.

Throughout the Midwest, diesel operators are getting record efficiency and economy with the help of STANDARD HD Oil. The Standard Oil lubrication specialist in your area will be glad to give you information concerning the use of this superior heavy-duty lubricant in plants with which you may be familiar. Just phone your local Standard Oil Company office for his services. Standard Oil Company, 910 S. Michigan Ave., Chicago 80, Illinois.

STANDARD HD
TRADE MARK
OIL

STANDARD OIL COMPANY

STANDARD *(Indiana)*